

LUMMI NATION MULTI-HAZARD MITIGATION PLAN 2015 UPDATE

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(LIBC)



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TABLE OF CONTENTS

1. Introduction	9
1.1. Goals and Objectives	10
1.2. Sections	11
2. Planning Process	13
2.1. Plan Preparation	13
2.1.1. Plan Preparation 2007 Update	14
2.1.2. Plan Preparation 2010 Update	14
2.1.3. Plan Preparation 2015 Update	14
2.2. Public Participation Process	15
2.3. Existing Documents Review	15
2.4. Plan Update Process	16
2.4.1. 2007 Update	16
2.4.2. 2010 Update	18
2.4.3. 2015 Update	21
3. LIBC Adoption	23
4. Description of the Lummi Reservation	25
4.1. Lummi Nation Government	25
4.2. Land Use and Socioeconomic Conditions	25
4.2.1. Historical Land Use	27
4.2.2. Current Land Use	28
4.2.3. Future Land Use	31
4.2.4. Population	33
4.2.5. Socioeconomic Conditions	33
4.2.6. Utilities	37
4.2.7. Emergency Services	38
4.3. Topography	39
4.4. Climate	40
4.5. Hydrogeology	40
4.5.1. Reservation Aquifers	42
4.5.2. Hydrologic Soil Groups	42
4.6. Reservation Watersheds	43
4.7. Surface Water Resources	44
4.7.1. Rivers, Sloughs, Streams, and Ditches	44
4.7.2. Springs and Wetlands	46
4.7.3. Estuarine and Marine Waters	48
5. Natural Hazard Risk Assessment	51
5.1. Assessment Areas	51
5.1.1. Lummi Peninsula Assessment Area	52
5.1.2. Floodplain Assessment Area	52
5.1.3. Northwest Upland Assessment Area	53
5.1.4. Portage Island Assessment Area	53
5.1.5. Sandy Point Peninsula Assessment Area	53
5.1.6. Gooseberry Point Assessment Area	53
5.2. Cultural Resources	59
5.3. Hazard Identification and Vulnerability Assessment	59
5.4. Floods	61
5.4.1. Profiles of Flood Hazards	61
5.4.1.1. Nooksack River Floods	61

5.4.1.2. Sequence of Nooksack River Flooding	63
5.4.1.3. Coastal Floods.....	68
5.4.2. Effects of Past Flood Events	68
5.4.2.1. Effects of Nooksack River Floods	68
5.4.2.2. Effects of Coastal Floods	72
5.4.3. Flood Vulnerability Assessment	76
5.4.3.1. FEMA Flood Zones.....	76
5.4.3.2. Nooksack River Flood Vulnerabilities.....	76
5.4.3.3. Coastal Floods Vulnerabilities.....	79
5.4.4. Potential Flood Losses	80
5.4.4.1. Nooksack River Floods Losses.....	80
5.4.4.2. Coastal Floods Losses	81
5.5. Earthquakes.....	82
5.5.1. Profiles of Earthquake Hazards	82
5.5.1.1. Types of Earthquake Hazards	82
5.5.1.2. Measurement Scales of Earthquakes and Earthquake Damages	83
5.5.1.3. Types of Earthquakes.....	86
5.5.2. Effects of Past Earthquake Events	87
5.5.2.1. Subduction Zone Earthquakes.....	87
5.5.2.2. Intraplate Earthquakes.....	90
5.5.2.3. Crustal Earthquakes	90
5.5.3. Earthquake Vulnerability Assessment	91
5.5.3.1. Earthquake Probabilities on the Reservation	91
5.5.3.2. Liquefaction on the Reservation.....	93
5.5.3.3. Possible Damages on the Reservation	93
5.5.4. Potential Earthquake Losses.....	94
5.6. Severe Winter Storms	99
5.6.1. Profiles of Winter Storm Hazards	100
5.6.2. Effects of Past Winter Storm Events.....	100
5.6.3. Winter Storm Vulnerability Assessment.....	100
5.6.4. Potential Winter Storm Losses	101
5.7. Windstorms	104
5.7.1. Profiles of Windstorm Hazards	104
5.7.2. Effects of Past Windstorm Events	104
5.7.3. Windstorm Vulnerability Assessment	105
5.7.4. Potential Windstorm Losses	105
5.8. Coastal Erosion.....	111
5.8.1. Profiles of Coastal Erosion Hazards.....	111
5.8.2. Effects of Past Coastal Erosion Events	111
5.8.3. Coastal Erosion Vulnerability Assessment	112
5.8.4. Potential Coastal Erosion Losses.....	113
5.9. Drought	117
5.9.1. Profiles of Drought Hazards	117
5.9.2. Effects of Past Drought Events.....	118
5.9.3. Drought Vulnerability Assessment.....	121
5.9.4. Potential Drought Losses	122
5.10. Wildfires	122
5.10.1. Profiles of Wildfire Hazards	122
5.10.2. Effects of Past Wildfire Events	123
5.10.3. Wildfire Vulnerability Assessment.....	123
5.10.4. Potential Wildfire Losses	124

5.11. Landslides	129
5.11.1. Profiles of Landslide Hazards	129
5.11.2. Effects of Past Landslide Events	130
5.11.3. Landslide Vulnerability Assessment	132
5.11.4. Potential Landslide Losses	133
5.12. Tsunamis	135
5.12.1. Profiles of Tsunami Hazards	135
5.12.2. Effects of Past Tsunami Events	136
5.12.3. Tsunami Vulnerability Assessment	136
5.12.4. Potential Tsunami Losses	138
5.13. Volcano	143
5.13.1. Profiles of Volcanic Hazards	143
5.13.2. Effects of Past Volcanic Events	143
5.13.3. Volcano Vulnerability Assessment	145
5.13.4. Potential Volcano Losses	146
5.14. Tornado	149
5.14.1. Profiles of Tornado Hazards	149
5.14.2. Effects of Past Tornado Events	150
5.14.3. Tornado Vulnerability Assessment	151
5.14.4. Potential Tornado Losses	151
5.15. Hazard Risk Assessment and Climate Change	152
5.16. Risk Assessment Summary	154
6. Mitigation Strategy	159
6.1. Hazard Mitigation Goals and Objectives	159
6.2. Mitigation Measures	161
6.2.1. All Hazards	162
6.2.1.1. Current All Hazard Mitigation Actions	162
6.2.1.2. Proposed All Hazard Mitigation Actions	164
6.2.2. Floods	169
6.2.2.1. Current Flood Mitigation Actions	169
6.2.2.2. Proposed Flood Mitigation Measures	173
6.2.3. Earthquakes	183
6.2.3.1. Current Earthquake Mitigation Actions	184
6.2.3.2. Proposed Earthquake Mitigation Measures	184
6.2.4. Severe Winter Storms	186
6.2.4.1. Current Winter Storm Mitigation Actions	186
6.2.4.2. Proposed Winter Storm Mitigation Measures	186
6.2.5. Windstorms and Tornadoes	188
6.2.5.1. Current Windstorm and Tornado Mitigation Actions	188
6.2.5.2. Proposed Windstorm and Tornado Mitigation Actions	188
6.2.6. Coastal Erosion	190
6.2.6.1. Current Coastal Erosion Mitigation Actions	190
6.2.6.2. Proposed Coastal Erosion Mitigation Actions	190
6.2.7. Drought	191
6.2.7.1. Current Drought Mitigation Actions	191
6.2.7.2. Proposed Drought Mitigation Actions	192
6.2.8. Wildfire	193
6.2.8.1. Current Wildfire Mitigation Actions	193
6.2.8.2. Proposed Wildfire Mitigation Actions	193
6.2.9. Landslide	196
6.2.9.1. Current Landslide Mitigation Actions	196

6.2.9.2. Proposed Landslide Mitigation Actions	196
6.2.10. Tsunami	197
6.2.10.1. Current Tsunami Mitigation Actions	197
6.2.10.2. Proposed Tsunami Mitigation Actions	198
6.2.11. Volcano	199
6.2.11.1. Current Volcano Mitigation Actions	199
6.2.11.2. Proposed Volcano Mitigation Actions	200
6.2.12. Mitigation Actions and Cultural Resources	200
6.2.13. Summary of Recommended Mitigation Actions	200
6.3. Mitigation Priorities	206
6.3.1. All Hazards	206
6.3.2. Floods, Tsunamis, and Volcanic Lahars	207
6.4. Action Plan	208
6.5. Tribal Capability Assessment	210
6.5.1. Tribal Capability Assessment	210
6.5.1.1. Land Use Plans and Development Regulations	210
6.5.1.2. Flood Damage Reduction Plan Policies	213
6.5.1.3. Wildfire Policies and Programs	213
6.5.1.4. All Hazards	213
6.5.2. Local Public Organizations	214
6.5.3. Mitigation Capability Effectiveness	214
6.6. Mitigation Funding Sources	215
7. Plan Maintenance Process	219
7.1. Responsibility for Plan Maintenance	219
7.2. Monitoring, Evaluating, and Updating the Plan	220
7.2.1. 2004 Update Process	220
7.2.2. 2007 Update Process	220
7.2.3. 2010 Update Process	221
7.2.4. 2015 Update Process	221
7.2.5. Planned Update Process 2015 through 2020	222
7.3. Monitoring Progress of Mitigation Actions	222
7.3.1. 2004 Monitoring Process	222
7.3.2. 2007 Monitoring Process	223
7.3.3. 2010 Monitoring Process	224
7.3.4. 2015 Monitoring Process	224
7.3.5. 2015 through 2020 Monitoring Process	224
7.4. Integration with Existing Plans	224
8. Conclusion	227
9. References	231
10. List of Acronyms and Abbreviations	245

LIST OF TABLES

Table 2.1 Summary of the Lummi Nation MHMP Changes (2004-2007)	17
Table 2.2 Summary of the Lummi Nation MHMP Changes (2007-2010)	19
Table 2.3 Summary of the Lummi Nation MHMP Changes (2010-2015)	21
Table 4.1 Current Land-Cover/Land-Use Types on the Lummi Reservation based on 2006 C-CAP mapping.....	31
Table 4.2 Employment Status of Lummi Tribal Members, 2003	37
Table 4.3 Descriptions of Hydrologic Soil Groups on the Lummi Reservation	43
Table 5.1 Number and Value of Structures in the Six Assessment Areas.....	55
Table 5.2 Nooksack River Flood Flows at the Ferndale Gage.....	64
Table 5.3 Vulnerability and Potential Losses of Structures to Floods	82
Table 5.4 Relationship Between Moment Magnitude Scale and Modified Mercalli Intensity	85
Table 5.5 Modified Mercalli Intensity, Peak Ground Acceleration, and Potential Effects.....	85
Table 5.6 Types of Earthquakes in the Pacific Northwest.....	86
Table 5.7 Notable Regional Earthquakes	89
Table 5.8 Estimated Earthquake Vulnerability of Selected Structures	96
Table 5.9 Recorded Major Winter Storm Events in the Reservation Region	102
Table 5.10 Recorded Windstorm Events in the Reservation Region	107
Table 5.11 Vulnerability and Potential Losses of Structures to Windstorms	110
Table 5.12 Recorded Coastal Erosion Events on the Reservation	114
Table 5.13 Vulnerability and Potential Losses of Structures to Coastal Erosion	117
Table 5.14 Recorded Drought Events in the Reservation Region.....	120
Table 5.15 Recorded Wildfires in the Reservation Region	125
Table 5.16 Vulnerability and Potential Losses of Structures to Wildfires	129
Table 5.17 Vulnerability and Potential Losses of Structures to Landslides	135
Table 5.18 Recent Regional and Worldwide Tsunami Events	138
Table 5.19 Vulnerability and Potential Losses of Structures to a Tsunami.....	142
Table 5.20 Past Volcanic Events at Mount Baker.....	144
Table 5.21 Fujita Tornado Damage Scale.....	149
Table 5.22 Past Tornado Events in Whatcom County and Washington State	150
Table 5.23 Vulnerability and Potential Losses of Structures to Tornadoes	152
Table 5.24 Summary of Hazard Vulnerability and Probability on the Reservation	156
Table 6.1 Proposed All Hazard Mitigation Actions.....	165
Table 6.2 Proposed Flood Mitigation Actions	174
Table 6.3 Proposed Earthquake Mitigation Actions	185
Table 6.4 Proposed Winter Storm Mitigation Measures.....	187
Table 6.5 Proposed Windstorm and Tornado Mitigation Actions	189
Table 6.6 Proposed Coastal Erosion Mitigation Actions	190
Table 6.7 Proposed Drought Mitigation Actions.....	192
Table 6.8 Proposed Wildfire Mitigation Actions	194
Table 6.9 Proposed Landslide Mitigation Actions.....	197
Table 6.10 Proposed Tsunami Mitigation Actions.....	199
Table 6.11 Summary of Recommended Mitigation Actions and Priorities by Hazard.....	201

LIST OF FIGURES

Figure 4.1 Regional Location of the Lummi Nation Reservation	26
Figure 4.2 Upland Use/Land Cover on the Lummi Reservation derived from NOAA C-CAP 2006	30
Figure 4.3 Households on the Lummi Reservation, 1910-2013	32
Figure 4.4 Current Land Use Zones on the Lummi Reservation	34
Figure 4.5 Topography, Surface Water Drainages, Place Names, and Roads of the Lummi Reservation	41
Figure 4.6 Hydrologic Soil Groups, Watersheds, and Surface Waters of the Lummi Reservation	45
Figure 4.7 Wetlands and Streams on the Lummi Reservation	47
Figure 5.1 Hazard Assessment Areas on the Lummi Reservation	54
Figure 5.2 Critical Facilities and Vulnerable Populations on the Lummi Reservation	58
Figure 5.3 Levees along the Lower Nooksack River and Lummi River, 1988	66
Figure 5.4 Modeled Level of Protection along the Lower Nooksack River	67
Figure 5.5 Flooding on the Reservation November 25, 1990.....	70
Figure 5.6 Area of Inundation in November 1990 and Historical Levee Breaches	71
Figure 5.7 Flood Effects at Gooseberry Point and Hermosa Beach, January 2, 2003	74
Figure 5.8 Storm Damage along Sandy Point, December 15, 2000	75
Figure 5.9 Federal Emergency Management Agency (FEMA) Flood Zones	77
Figure 5.10 Estimated Flood Vulnerabilities in Reservation Areas	78
Figure 5.11 Types of Earthquakes in the Pacific Northwest.....	87
Figure 5.12 Locations of Recorded Earthquakes and Faults in the Reservation Region.....	88
Figure 5.13 Estimated Earthquake Vulnerabilities in Reservation Areas	95
Figure 5.14 Estimated Winter Storm Vulnerabilities in Reservation Areas.....	103
Figure 5.15 Estimated Windstorm Vulnerabilities in Reservation Areas	109
Figure 5.16 Erosion Damage along Lummi Shore Road and Lummi Shore Drive, 2003 and 2006.....	115
Figure 5.17 Estimated Coastal Erosion Vulnerabilities along Reservation Shorelines	116
Figure 5.18 Recorded Wildfire Locations and Sizes in the Reservation Region, 1970 to June 2015.....	127
Figure 5.19 Estimated Wildfire Vulnerabilities and Locations of Recorded Wildfires in Reservation Areas	128
Figure 5.20 Landslides at West Beach, Lummi Peninsula	131
Figure 5.21 Estimated Landslide Vulnerabilities in Reservation Areas	134
Figure 5.22 Modeled Tsunami Inundation in the Bellingham Area from a Cascadia Subduction Zone Earthquake.....	140
Figure 5.23 Estimated Tsunami Vulnerabilities in Reservation Areas	141
Figure 5.24 Mount Baker Eruption History and Regional Volcanic Hazards	147
Figure 5.25 Estimated Volcano Vulnerabilities in Reservation Areas.....	148
Figure 5.26 Combined Relative Multi-Hazard Vulnerability on the Reservation	158
Figure 6.1 Locations of Recommended Flood Mitigation Priorities	209

APPENDICES

Appendix A: LIBC Resolution No. 2004-015, “Adoption of the Lummi Nation Multi-Hazard Mitigation Plan”

LIBC Resolution No. 2007-060, “Adoption of the 2007 Lummi Nation Multi-Hazard Mitigation Plan”

LIBC Resolution No. 2010-093, “Adoption of the 2010 Lummi Nation Multi-Hazard Mitigation Plan”

LIBC Resolution No. 2015-107, “Adoption of the 2015 Lummi Nation Multi-Hazard Mitigation Plan”

Appendix B: PowerPoint Presentation on the Multi-Hazard Mitigation Plan to the Multi-Hazard Mitigation Team (August 20, 2015) and the Lummi Indian Business Council (September 1, 2015)

Appendix C: Lummi Nation Comprehensive Emergency Management Plan

Appendix D: Lummi Nation Flood Damage Prevention Code, Lummi Code of Laws Title 15A

Appendix E: Summary of Lummi Nation Flood Policies

Appendix F: Tsunami Evacuation Brochure and Map for the Lummi Reservation

Appendix G: Letter to Institutions, Businesses, and Interested Parties on the Reservation

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EXECUTIVE SUMMARY

The purpose of this Lummi Nation Multi-Hazard Mitigation Plan (MHMP) is to guide current and future efforts to mitigate the impacts of natural hazards on the Lummi Indian Reservation (Reservation). The MHMP shall also guide efforts to mitigate and respond to natural hazards that are generated off-Reservation or that cross Reservation boundaries in coordination with other agencies and jurisdictions as appropriate.

The Lummi Nation finds that natural hazards on the Reservation have a direct, serious, and substantial effect on the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation. Further, the Lummi Nation finds that those activities that potentially increase the frequency or severity of damages from natural hazards, if left unregulated or unaddressed, will eventually cause such damages (LIBC Resolution No. 2004-015, No. 2007-060, No. 2010-093, and No. 2015-107; Appendix A). The MHMP assessed the vulnerability of six geographic areas of the Reservation (i.e., Lummi Peninsula, Gooseberry Point, Floodplain, Northwest Upland, Sandy Point Peninsula, and Portage Island) to natural hazards and found that the Reservation is vulnerable to floods, earthquakes, severe winter storms, windstorms, coastal erosion, drought, wildfires, landslides, tsunamis, volcanic eruptions, and tornadoes.

The MHMP proposes mitigation measures for all existing natural hazards and recommends the following specific priorities for flood, tsunami, and volcanic lahar mitigation:

1. Protect the Nooksack River floodplain on the Reservation and maintain access to the Lummi Peninsula by constructing a 100-year setback levee that extends along Ferndale Road from Ferndale to Kwina Slough, then along the north side of Kwina Slough to Marine Drive, and finally along Marine Drive to Lummi Shore Road (the levee should include a bridge over the Lummi River channel and culverts allowing flow under Marine Drive).
2. Reduce the potential for flood damage along the low-lying coastal areas and concurrently reduce damage to shoreline resources by bulkheads through the acquisition or relocation of flood-prone structures currently located in the coastal velocity zones.
3. Complete the elevation of Slater Road to the 100-year flood level east of the Nooksack River including a bridge to allow floodwaters to pass downstream.
4. Protect, acquire, or relocate vulnerable structures in the coastal and riverine floodplains, outside of the velocity zone and floodway, respectively.
5. Provide access to the Lummi Peninsula in the case of levee failure by raising Haxton Way and providing for the flow of floodwaters under Haxton Way (this could serve as an interim measure prior to construction of a 100-year setback levee).
6. Purchase flood insurance for all LIBC structures within or adjacent to the floodplain.
7. Maintain the tsunami warning system and evacuation route signs in hazard areas and continue to provide residents in the tsunami hazard areas with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami.

In addition, the following priorities are recommended for all natural hazards:

1. Establish an Emergency Management Division within the Lummi Nation Police Department and hire an Emergency Manager (at least 0.5 FTE).
2. Establish emergency medical response capability (an equipped Medic 1 unit along with paramedics and emergency medical technicians) located on the Reservation.
3. Purchase, or make available for purchase, 9-1-1 house number signs for all addressed structures on the Reservation to aid emergency responders.
4. Promote the establishment and maintenance of home survival/emergency kits.
5. Pursue funding for the Lummi Nation mitigation priorities and recommendations described in this MHMP, including funding for needed staff and infrastructure.
6. Improve and sustain public education programs aimed at mitigating natural hazards.
7. Redirect and/or relocate development away from hazard areas.
8. Encourage seismic strength evaluations of schools, public infrastructure, and critical facilities on the Reservation to identify vulnerabilities and help prioritize mitigation to meet current seismic standards.
9. Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.
10. Continue to develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.
11. Continue monitoring of erosion rates along the shorelines of the Reservation.
12. Limit construction in identified landslide areas through regulation and outreach.

The MHMP works in coordination with the development regulations and management programs of the Lummi Nation. These measures include: the Natural Resources Code (Lummi Nation Code of Laws [LCL] Title 10), the Tidelands Code (Title 13), the Land Use, Zoning, and Development Code (LCL Title 15), the Flood Damage Prevention Code (LCL Title 15A), the Water Resources Protection Code (LCL Title 17), the Solid Waste Control and Disposal Code (LCL Title 18), the Building Code (LCL Title 22), the Cultural Resources Protection Code (LCL Title 40), the Lummi Nation Coastal Zone Management Plan, the Comprehensive Emergency Management Plan, and the Comprehensive Water Resources Management Program. The MHMP for the Reservation supports and complements these existing programs and activities and promotes continued involvement in off-Reservation hazard mitigation-related activities.

The Lummi Nation MHMP was prepared by the Water Resources Division (LWRD) of the Lummi Natural Resources Department (LNR) and complies with 44 Code of Federal Regulations (CFR) Part 201 and its amendments. The MHMP was first adopted by the LIBC through Resolution No. 2004-015 in January 2004 and approved by the Federal Emergency Management Agency (FEMA) in May 2004. The MHMP was comprehensively updated in 2007 (adopted by LIBC Resolution No. 2007-060), 2010 (adopted by LIBC Resolution No. 2010-093), and 2015 (LIBC Resolution No. 2015-107).

During the three years between adoption of the original plan and the 2007 update, several of the identified mitigation activities were undertaken. These included:

- The Multi-Hazard Mitigation Team (MHMT) was formed in 2004 pursuant to LIBC Resolution No. 2004-015 and consisted of the Natural Resources Department Executive Director, the Planning and Public Works Department Director, the Chief of the Lummi Nation Police, the LIBC Safety Officer, and assigned staff from the Natural Resources and Planning and Public Works departments. The MHMT met five times between 2005 and 2007 to discuss and review progress on mitigation projects, review the Lummi Nation Comprehensive Emergency Management Plan and Lummi Nation Spill Prevention and Response Plan, and discuss the MHMP update.
- A 2005 FEMA Pre-Disaster Mitigation-Competitive (PDM-C) grant was received for a total project cost of \$5,976,843 and a 75 percent federal share of \$4,482,632. The grant included two project subgrants and one management subgrant. The two projects were:
 - Slater Road Elevation Project – This project called for the elevation of an approximately 1 mile long, frequently flooded section of Slater Road east of the Nooksack River bridge to above the 100-year flood level. The elevation project was planned to include an approximately 400 foot long bridge that would allow continued access to the Reservation, Lummi Island, and nearby industries through a 100-year flood event. The project was targeted for completion by January 31, 2009. Because the cost estimates for Slater Road Elevation Project exceeded the available funding (shared between the Lummi Nation and Whatcom County), and additional funding sources needed to be identified, the grant reached its 5 year time limit and could not be used for the project. Efforts to secure the needed funding continue.
 - Sandy Point Coastal Acquisition Project – This project included the acquisition and removal of up to three homes from the high velocity coastal flood zone (V Zone) along the Sandy Point Peninsula.
- A 2006 Emergency Management Preparedness Assistance Grant (EMPAG) for \$94,200 was received from the Washington State Emergency Management Division for the turn-key installation of two All-Hazard Alert Broadcast (AHAB) tsunami warning systems to provide notification of tsunamis and other hazards to Reservation residents.
- Work was initiated with Whatcom County and the Washington State Emergency Management Division to develop tsunami evacuation route maps and brochures for the Reservation.
- The Lummi Nation MHMP, the Pre-Disaster Mitigation planning grant application, and the Pre-Disaster Mitigation project grant applications were shared with at least eight tribes including tribes in Massachusetts, Oklahoma, Idaho, Oregon, and Washington.
- The Lummi Indian Business Council adopted the Comprehensive Emergency Management Plan (CEMP) by LIBC Resolution No. 2006-036.
- The Lummi Nation Spill Prevention and Response Plan was completed in 2005 and is being implemented through spill preparedness and response efforts including equipment purchases, deployment (practice and response), and training.
- The Planning and Public Works Department developed a draft Lummi Nation Comprehensive Plan.
- The Water Resources Division of the Natural Resources Department began the process to join the Community Rating System (CRS) of the National Flood Insurance Program.

- The Forestry Division of the Natural Resources Department obtained equipment and training for wildland firefighting.
- The Lummi Nation's participation in the National Flood Insurance Program (NFIP) was improved through a Community Assistance Visit (CAV) with FEMA that closed on April 28, 2005.
- Twelve articles describing and providing updates on the mitigation projects and recommending preparedness measures such as family disaster plans and 72-hour emergency kits were published in the monthly Lummi Nation newspaper (Squol Quol).

Additionally, review of the 2004 hazard identification and vulnerability assessment led to the addition of one hazard (tornado), the refinements of the earthquake, tsunami, landslide, and coastal erosion maps through the addition of new information, and the reduction of risks for certain hazards through mitigation activities. The review of the mitigation measures led to the addition of recommendations to establish an Emergency Management Division within the Lummi Nation Police Department and hire an Emergency Manager (at least 0.5 FTE), purchase flood insurance for LIBC structures within or adjacent to the floodplain, and pursue FEMA elevation certificates for tribal homes in the floodplain. The review of the Plan Maintenance Process led to minor changes in the Multi-Hazard Mitigation Team's meeting, reporting, and project tracking processes.

The 2007 MHMP was comprehensively reviewed and updated in 2010. In accordance with newly developed guidance from FEMA, the plan changed from a state-level plan to a tribal plan. Notable differences in requirements between the two types of plan included: (1) stronger emphasis in the tribal plan on the documentation of the planning process, (2) consideration of cultural resources in the vulnerability assessment and resulting mitigation actions, and (3) stronger involvement of the public and interested parties in the maintenance and update of the plan. Also, the required plan update interval increased from three years to five years.

During the three years between the adoption of the 2007 MHMP and adoption of the 2010 MHMP, several mitigation actions were implemented. These included:

- Between 2007 and 2010, the Multi-Hazard Mitigation Team (MHMT) met four times to discuss and review mitigation projects and the MHMP update and over ten times to discuss the Slater Road Elevation Project.
- The Slater Road Elevation Project was fully designed and engineered and largely permitted by October 2007, but the estimated costs exceed the funds available through the 2005 PDM-C grant and the interlocal agreement with Whatcom County. The subgrant was terminated during May 2010 because the project could not be completed before the five year maximum allowable project duration was exceeded. Efforts continue to secure additional funding for the project.
- The installation of the All-Hazard Alert Broadcast (AHAB) warning systems was completed, the tsunami warning and evacuation signs were installed, and an accompanying tsunami evacuation route brochure was developed and distributed to all Reservation residents. Maintenance of the evacuation route signs is ongoing in coordination with Washington State and Whatcom County. Several Squol Quol articles have provided additional information about tsunamis and tsunami mitigation strategies.

- Construction commenced on the Smuggler's Slough Restoration Project, which will include the elevation of a section of Marine Drive between Kwina Slough and Lummi Shore Road with provisions for underflow.
- The Lummi Nation's participation in the National Flood Insurance Program was improved through a second Community Assistance Visit (CAV) with FEMA during 2007.
- The Water Resources Division completed the application to join the Community Rating System (CRS) during 2009 and the Lummi Nation joined the CRS on May 1, 2010.
- Eleven articles describing and providing updates on the mitigation projects and recommending preparedness measures such as family disaster plans and 72-hour emergency kits were published in the monthly Lummi Nation newspaper (Squol Quol).

During the five years between the adoption of the 2010 MHMP and adoption of the 2015 MHMP, several mitigation actions were implemented. These included:

- Between June 2010 and June 2015, the Multi-Hazard Mitigation Team (MHMT) met one time to discuss current mitigation projects and identify proposed mitigation actions to pursue in the near-term future. Over this same time period, informal MHMT subcommittees met more than 10 times to discuss the Coastal Flood Study (RiskMAP) Partnership Agreement, the Community Rating System Community Verification Visit, the 9-1-1 addressing project, the Comprehensive Emergency Management Plan (CEMP) update, and the Whatcom County Floodplains by Design project, as well as participated in the LIBC Safety Committee meetings.
- Pursuant to LIBC Resolution 2010-093, which adopted the 2010 update to the MHMP, the Cultural Resources Department Director was appointed as a member of the Multi-Hazard Mitigation Team.
- The 2015 update to the Comprehensive Emergency Management Plan (CEMP) was adopted by LIBC Resolution No. 2015-086. Two training sessions and two drills were preformed to exercise the plan.
- The Lummi Spill Response Team continued implementing spill preparedness and response efforts including equipment purchases, deployment (practice and response), and training.
- In 2011, a section of Marine Drive was elevated and a box culvert and self regulating tide gate to provide for underflow were installed as part of the Smuggler's Slough Restoration Project to improve salmon habitat and reduce flooding in the area.
- Acquisition and removal of structures in flood-prone areas of the Reservation included two structures purchased with Hazard Mitigation Grant Program (HMGP) funds (one on the Sandy Point Peninsula and one in Floodplain assessment area) in 2010 and one structure acquired by the LIBC as part of the Smuggler's Slough Restoration Project in 2011.
- The Lummi Nation's participation in the National Flood Insurance Program was improved through a third Community Assistance Visit (CAV) with FEMA during 2012.

- Following the Community Rating System (CRS) Community Verification Visit in September 2013, the Lummi Nation's CRS rating improved to a Class 7, increasing the flood insurance premium discount in the Special Flood Hazard Areas (SFHAs) on the Reservation to 15 percent effective October 1, 2014.
- In 2013, the Coastal Flood Study (RiskMAP) Partnership Agreement was signed. Project deliverables will include an updated Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMS) for the coastal areas of the Reservation, as well as other non-regulatory products (e.g., BFE+ grid). Project completion is expected in December 2016.
- The LNR Forestry Division updated the Lummi Nation Forest Management Plan in 2011 and continued to issue burning permits and distribute wildfire brochures for public education.
- In August 2011, the Lummi Natural Resources Department (LNR) and Lummi Nation Police Department (LNPd) co-hosted a Thursday Safe Streets Walk ("Hazard Walk") with staff available to discuss and provide educational materials concerning floods (e.g., Flood Insurance Rate Maps [FIRMs], National Flood Insurance Program [NFIP] brochures), tsunamis (e.g., tsunami simulation for the Reservation), LNPd response capabilities (e.g., Incident Command Vehicle), and home preparedness (e.g., 72-hour emergency kits, emergency radios).
- In April 2012, the LIBC Safety Officer and LNPd provided a two hour Lummi Emergency Management Training: Disaster Preparedness for community members.
- In April 2012, the LNPd provided a three day Community Emergency Response Team (CERT) Training.
- In September 2013, the LNR and LNPd co-hosted a second Thursday Safe Streets Walk, this time called the "Community Disaster Preparedness Walk." Education and outreach activities were similar to those provided at the August 2011 event.
- Over fifteen articles describing and providing updates on the mitigation projects and recommending preparedness measures such as 72-hour emergency kits and tsunami preparedness were published in the Squol Quol.
- Beginning in 2013, contractors implementing the 9-1-1 addressing project have installed approximately 820 house number signs at tribal member owned homes on the Reservation to date. These signs have white numbers on a blue background and are reflective, helping to improve safety by ensuring that first-responders can quickly locate to the correct house in the event of an emergency. Initial efforts have focused on signage on the Lummi Peninsula; additional funding is needed to expand the addressing project to other areas of the Reservation.
- The LIBC Emergency Notification Text Messaging System was developed in 2014. This system allows the Chairman's and/or Vice Chairman's office to send emergency notifications via text message to LIBC directors and key staff who have registered their cell phone number and service provider with administrators. The text system currently serves LIBC officers, the Police, Planning and Public Works, and Natural Resources departments, the Tribal Health Clinic, the Northwest Indian College, and the Lummi Nation School. Expansion of this program to other departments and tribal institutions is planned.

- In 2015, the draft Assessment of Climate Change Impacts on the Lummi Indian Nation was developed by staff of the Lummi Water Resources Division. The purpose of this assessment was to evaluate the potential impacts of anthropogenic climate change on the Reservation, Lummi Usual and Accustomed Grounds and Stations (U&A), and Lummi Traditional Territories and present both mitigation strategies that may reduce the causes of climate change and adaptation strategies that may minimize climate change impacts that cannot be avoided.

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1. INTRODUCTION

The purpose of this Lummi Nation Multi-Hazard Mitigation Plan (MHMP) is to guide current and future efforts to effectively and efficiently mitigate the impacts of natural hazards on the Lummi Indian Reservation (Reservation). It shall also guide efforts to mitigate and respond to natural hazards that are generated off-Reservation or that cross Reservation boundaries in coordination with other agencies and jurisdictions as appropriate. This Lummi Nation MHMP establishes goals, lists objectives necessary to achieve the goals, and identifies policies, tools, and actions that will help meet the objectives. These actions will reduce the potential for losses on the Reservation due to natural hazards. In short, this plan is intended to help create a disaster-resistant Reservation by reducing the threat of natural hazards to life, property, emergency response capabilities, economic stability, and infrastructure, while encouraging the protection and restoration of natural resources and cultural properties.

The natural hazards that have affected the Reservation in the past and that will affect the Reservation in the future include floods, earthquakes, severe winter storms, coastal erosion, windstorms, wildfires, drought, and landslides. Although the probability of occurrence for some of these hazards is low, the potential for damaging events, however rare, is real. With the combination of high vulnerability and high probability of both Nooksack River and coastal flooding, the flood hazard on the Reservation poses the largest natural hazard in terms of potential annual damages to structures, government services, and economic activity. In addition, volcanic activity from Mt. Baker and a tsunami have a low probability of occurrence, but are potentially large hazards on the Reservation. The Reservation also has a very low vulnerability to tornadoes.

To protect the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation, it is important for the Lummi Nation to minimize threats to public health and safety and damage to property from future hazard events. In developing a policy response, it is important to recognize that floods, earthquakes, severe winter storms, windstorms, wildfires, landslides, and other such events are naturally occurring processes that will present occasional disruption to the lives of Reservation residents. Any policy must also recognize that there are many private and public structures and facilities that have been constructed through time without regard to potential natural hazards. At the same time, there are many actions that can be taken to reduce future risk and loss including structural and non-structural projects and regulatory measures.

This MHMP is one such action to reduce future risk and losses since it evaluates risks and identifies mitigation actions and also will qualify the Lummi Nation for funding under the Pre-Disaster Mitigation (PDM) Program that is administered by the Federal Emergency Management Agency (FEMA). This program provides funding for hazard mitigation planning and for mitigation projects that are implemented before a disaster occurs. This plan may also help the Lummi Nation acquire funding under other programs listed in Section 6.6.

With this eligibility for grant programs, there is an opportunity to look to the future and work cooperatively and creatively to mitigate future damages and threats to public health and safety. This Multi-Hazard Mitigation Plan addresses the primary natural hazards that threaten the

Reservation. Although many of the specific recommendations in the plan are directed at the Reservation, many will be most effective if implemented on a basin-wide basis. It is therefore intended that this plan provides solutions that other jurisdictions can use and benefit from and that can be cooperatively implemented.

1.1. Goals and Objectives

The goals of the Lummi Nation MHMP are to:

1. Reduce the threats to public health and safety posed by natural hazards;
2. Reduce structural damages caused by natural hazards;
3. Reduce the environmental impacts of natural hazards, mitigation actions, and future development activities including impacts to cultural properties; and
4. Reduce the long-term costs resulting from natural hazards and their mitigation.

The objectives of the Lummi Nation MHMP are the following:

1. Discourage new development in areas that are vulnerable to hazards or ensure that development occurs in such a way that risk is minimized.
2. Protect or alter existing development in hazardous areas to make it less susceptible to damage.
3. Ensure that the solution chosen to protect existing development is the most cost-effective available; protects or enhances cultural properties, natural resources, and sensitive terrestrial, riparian, or coastal habitats; and is consistent with applicable land use plans and regulations.
4. Ensure that the benefits of maintaining existing facilities outweigh their costs; if not, redesign facilities to make them less susceptible to damage or implement some other type of solution at the site.
5. Redesign existing projects and/or change maintenance practices to protect or enhance riparian or coastal habitats.
6. Manage floodplains, rivers, streams, and other water resources for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, finfish and shellfish harvesting, open space, recreation, water supply, cultural/traditional practices, and hydropower.
7. Improve coordination and consistency between the Lummi Nation and other jurisdictions, as appropriate, in management activities for floodplain and coastal areas.
8. Increase public awareness of natural hazards and improve appropriate preparation for and response to such hazards.
9. Improve hazard warning and emergency response systems.

As part of the 2007 plan update, these goals and objectives were reviewed by the Multi-Hazard Mitigation Team on January 25, 2007 and by members of the Lummi Fisheries and Natural Resources, Lummi Planning, and Lummi Cultural commissions on February 28, 2007 and determined to still be valid. During the course of the 2010 update, the goals and objectives were

confirmed by the Multi-Hazard Mitigation Team on May 4, 2010. During the 2015 update, the goals and objectives were again confirmed by the Multi-Hazard Mitigation Team on August 20, 2015.

1.2. Sections

This MHMP is organized into the following sections:

- Section 1 is this introduction.
- Section 2 describes how the MHMP was prepared and updated.
- Section 3 describes the LIBC adoption process.
- Section 4 describes the land use, socioeconomic conditions, and physical characteristics of the Reservation.
- Section 5 presents an assessment of hazard risks on the Reservation.
- Section 6 presents the Lummi Nation mitigation strategy.
- Section 7 describes the MHMP maintenance process.
- Section 8 presents a summary and conclusions.
- Section 9 is a list of references cited in this plan.
- Section 10 is a list of acronyms and abbreviations.

The appendices follow Section 10.

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2. PLANNING PROCESS

The current pre-disaster mitigation planning effort on the Lummi Reservation is intended to complement existing Lummi Indian Business Council (LIBC) programs. The Multi-Hazard Mitigation Plan (MHMP) had been developed and updated pursuant to the requirements for State, Local, and Tribal Mitigation Plans, 44 Code of Federal Regulations (CFR), Part 201 and its associated plan review crosswalk. The Lummi Nation will continue to comply with all applicable Federal statutes and regulations in effect during periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d).

2.1. Plan Preparation

The original Lummi Nation Multi-Hazard Mitigation Plan (LWRD 2004) was the first state-level Multi-Hazard Mitigation Plan approved by FEMA nationwide. The development of the initial version of the plan was funded as a pilot project by a Pre-Disaster Mitigation (PDM) Program Grant (Grant No. EMS-2002-GR-4018) by FEMA. The Water Resources Division of the Lummi Natural Resources Department was assigned the lead in developing the original plan in 2004 with the Water Resources Planner II as primary author and the Water Resources Manager, the GIS Manager, and the Water Resources Specialist as the primary contributors.

The 2004 MHMP was reviewed by staff of the Lummi Natural Resources Department (LNR), Lummi Planning Department, and Lummi Cultural Resource Management Program, as well as by the Lummi Chief of Police, Lummi Indian Business Council (LIBC) Safety Officer, and LIBC Training Officer. A Microsoft PowerPoint slide presentation about the MHMP, including the proposed mitigation priorities and action plan, was developed and presented to members of the Lummi Fisheries and Natural Resources Commission, the LNR Executive Director, and the LNR Environmental Director. Based on comments received, a revised 45-minute presentation was presented to the Lummi Fisheries and Natural Resources Commission, Lummi Planning Commission, Lummi Law and Justice Commission, and staff of the LIBC Cultural Resource Management Program. These groups received the MHMP Executive Summary, a list of the proposed mitigation measures in the MHMP, and the proposed MHMP action plan for review before the PowerPoint presentation. The comments received during this review process were incorporated into the final version of the 2004 MHMP.

Based on this review process, the Lummi Fisheries and Natural Resources Commission, Lummi Planning Commission, Lummi Law and Justice Commission, Lummi Fisheries and Natural Resources Commission Chairman, LNR Executive Director, and Lummi Planning Department Director all recommended that the Lummi Indian Business Council adopt the MHMP. The MHMP, the MHMP Executive Summary, a list of the proposed mitigation measures, the proposed MHMP action plan, and a resolution adopting the MHMP were then presented to the LIBC for review. The LIBC, the governing body of the Lummi Nation, passed Resolution No. 2004-015 (Appendix A) on January 19, 2004, to formally adopt the 2004 MHMP. The Multi-Hazard Mitigation Team (MHMT) was formed in 2004 pursuant to LIBC Resolution No. 2004-015 and consists of the Natural Resources Department Executive Director, the Planning and Public Works Department Director, the Chief of the Lummi Nation Police Department, the

Cultural Resources Department Director (appointed in 2010 pursuant to LIBC Resolution No. 2010-093), the LIBC Safety Officer, and assigned staff from the Natural Resources, Planning and Public Works, and Cultural Resources departments. The MHMT is responsible for pursuing the identified mitigation actions, reviewing new action needs, and for maintaining the plan.

2.1.1. Plan Preparation 2007 Update

The Water Resources Analyst of the Water Resources Division was responsible for the update of the plan in 2007 with the Water Resources Manager and the GIS Manager as primary contributors. The update process included a review by the Multi-Hazard Mitigation Team of all aspects of the plan including its goals and objectives, the identified hazards, the vulnerability of the Reservation and critical facilities to these hazards, the potential losses, the capability assessment, the mitigation measures and priorities, and the plan maintenance process. A joint meeting of the Lummi Natural Resources Commission, Lummi Planning Commission, Lummi Law and Justice Commission, and the Lummi Cultural Commission was held on February 27, 2007 to seek the commissioners' comments for the update. A presentation was given to the commissioners to review the original plan, explain the update requirement, seek comment on the vulnerability assessment and mitigation strategy, and seek approval of the update approach and proposed changes. Based on the recommendation of the commissioners, the updated plan was presented at a regular meeting of the Lummi Indian Business Council on April 16, 2007. The LIBC adopted the updated plan by Resolution No. 2007-060 (Appendix A).

2.1.2. Plan Preparation 2010 Update

The Natural Resources Analyst of the Water Resources Division was responsible for the update in 2010 with the Water Resources Manager and the new GIS Manager as primary contributors. At that time, the status of the plan changed from a state-level Multi-Hazard Mitigation Plan to a Tribal Multi-Hazard Mitigation Plan pursuant to the amendments to 44 CFR Part 201 in 72 Fed. Reg. 61720 published in October 2007. A meeting of the Multi-Hazard Mitigation Team was held on May 4, 2010, to review the original plan and the updates, explain the update requirement, seek comment on the vulnerability assessment and mitigation strategy, and seek approval of the update approach and proposed changes. Following the recommendation by the MHMT, the updated plan was presented to the Lummi Fisheries and Natural Resources Commission on May 14, 2010, to the Lummi Planning Commission on May 5, 2010, to the Lummi Cultural Resources Commission on May 18, 2010, and to the Lummi Law and Justice Commission on May 11, 2010. Following the recommendations of the MHMT and the commissions, the updated plan was presented to the LIBC on May 25, 2010, and adopted by the Resolution No. 2010-093 (Appendix A).

2.1.3. Plan Preparation 2015 Update

The Natural Resources Analyst of the Water Resources Division was responsible for the update in 2015 with the Water Resources Manager and the GIS Manager as primary contributors. A meeting of the Multi-Hazard Mitigation Team was held on August 20, 2015, to review the original plan and subsequent updates, seek comment on the vulnerability assessment and mitigation strategy, and seek approval of the update approach and proposed changes. Following the recommendations of the MHMT, the updated plan was presented to the LIBC on September 1, 2015, and adopted by Resolution No. 2015-107 (Appendix A). Because there were no substantive changes made to the goals and objectives, hazard vulnerability rankings, or

mitigation priorities of the MHMP and there were no new federal requirements for tribal multi-hazard mitigation plans issued by FEMA over the 2010 to 2015 period, it was determined that the 2015 update to the MHMP did not need to be reviewed by the LIBC commissions as had been done during the 2007 and 2010 plan updates.

2.2. Public Participation Process

For the original Multi-Hazard Mitigation Plan prepared in 2004 and the update in 2007, the public was defined as the LIBC and the commissions of the LIBC because the commissions of the LIBC are either elected by the General Council or appointed by the LIBC, hold meetings open to the public, and are consulted on relevant mitigation projects. For the transition to a tribal multi-hazard mitigation plan in 2010, a wider definition of the public was required that included business owners, institutions like the Northwest Indian College (NWIC), and other interested parties. In order to reach this wider base of constituents, an article was published in the March 2010 issue of the Squol Quol (Lummi Newspaper) that called for public input. Institutions and business interests on the Reservation were targeted with a letter that introduced the interested parties to the update process and also asked for comments and suggestions. Only one comment was received. The radio flyer club on the Reservation expressed their support. For the 2015 update, public participation was again solicited through an article in the Squol Quol, appearing in the May 2015 issue, and through a letter mailed to interested parties on May 1, 2015 (Appendix G). No public comments were received.

2.3. Existing Documents Review

The multi-hazard mitigation planning process began with a literature review conducted by Lummi Natural Resources Department (LNR) staff in 2004. The Whatcom County Hazard Identification and Vulnerability Analysis (Whatcom County 2002), developed by the Whatcom County Division of Emergency Management (DEM), and the Washington State Hazard Identification and Vulnerability Assessment (WEMD 2001), developed by the Washington State Emergency Management Division (WEMD), were also reviewed for information regarding the natural hazards present on the Reservation. The State of Oregon, Clackamas County, Kitsap County, City of Redmond, and Portland Metro hazard mitigation plans (Oregon 2000a; Clackamas County 2002; Kitsap County 1999; City of Redmond 2002; and Portland Metro 1999) were reviewed for information and mitigation alternatives pertinent to the natural hazards on the Reservation. The FEMA how-to guides on mitigation planning, available on the FEMA website, were used to guide the planning process, to help assess hazard risks and vulnerabilities, and to develop the MHMP.

The MHMP built on the Lummi Nation Flood Damage Prevention Code (LCL Title 15A), the Lummi Coastal Zone Management Plan, the Lummi Reservation Comprehensive Plan, and the Comprehensive Water Resources Management Program (CWRMP); involvement by the Lummi Nation in the planning process for the Lower Nooksack River Comprehensive Flood Hazard Management Plan (Whatcom County 1999), which was developed by neighboring Whatcom County; and the development of the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a). The Revised Preliminary Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) for the Lummi Reservation (FEMA 2003c and 2003d) were used to identify the

flood-prone areas on the Reservation. This information was refined after the issuance of the final FIRMs for the Reservation in January 2004, and again after revised FIRMs were published in November 2007. A small area of known flooding along Lummi Shore Road not identified on the associated FIRM was also considered to be flood-prone. The recorded flood history (Whatcom County 1995a) and newspaper articles on recent flood events (LWRD 2001a) were reviewed for information on past damages and hazards. Current and future flood hazards on the Reservation were determined by identifying currently developed properties and current land uses in the flood-prone areas and by reviewing land use zoning on the Reservation. Flood hazards in potential velocity zones were made a high priority for potential flood mitigation.

For other natural hazards, pertinent literature and websites were reviewed for current information on past hazard events and hazard vulnerability. In addition, staff of the WEMD provided a Hazards-U.S. (HAZUS) analysis of the estimated potential earthquake damage on the Reservation. A coastal management and planning services consulting firm, Coastal Geologic Services Inc., hired by the Natural Resources Department, provided an assessment of coastal erosion vulnerability and information on landslide hazards on the Reservation. The GIS Division of the LNR supported the development of the plan by generating maps and conducting spatial analyses.

Natural hazard mitigation activities currently in place were identified and evaluated for their future effectiveness. This evaluation of the effectiveness of current mitigation was compared with the assessment of natural hazards to identify which hazards required additional mitigation measures. Short-term and long-term mitigation alternatives for each hazard were identified, evaluated, and prioritized. These mitigation alternatives were then used to develop an action plan to address the primary natural hazards on the Reservation.

2.4. Plan Update Process

2.4.1. 2007 Update

The three-year update of the plan was completed pursuant to the requirements in the Interim Final Rule for Hazard Mitigation Planning (44 Code of Federal Regulations [CFR], Parts 201 and 206, February 26, 2002), Part 1 of the November 2006 Multi-Hazard Mitigation Planning Guidance for Standard State Mitigation Plans, the Standard State Hazard Mitigation Plan Review Crosswalk, and the FEMA Mitigation Planning How-To Guide, *Bringing the Plan to Life: Implementing the Hazard Mitigation Plan* (FEMA 2003a). The 2007 update was performed by first reviewing FEMA guidance and requirements, reviewing and organizing information collected on specific hazard knowledge and occurrences, and gathering input from the Multi-Hazard Mitigation Team (MHMT) and the relevant Lummi commissions.

The 2004 version of the MHMP was then modified by updating the description of the Reservation, the natural hazard risk assessment, and the mitigation strategy. The assessment of each hazard was updated as appropriate to include new information, new hazard occurrences, input on vulnerabilities from the MHMT and commissions, and current valuation data for the loss estimates. New sources of information on hazards that were incorporated included the final January 16, 2004 Flood Insurance Rate Maps (FEMA 2004), the January 16, 2004 Flood Insurance Study for Whatcom County (FEMA 2004a), the Washington State Enhanced Hazard

Mitigation Plan (WEMD 2004), and the Whatcom County Natural Hazards Mitigation Plan (Whatcom County 2004). New data used in the GIS analyses include digital elevation models developed from Light Imaging Detection and Ranging (LIDAR) data collected for the Reservation, a 2007 addressed structure layer, and the 2007 Whatcom County Assessor's database. All of the vulnerability maps were revised to include current GIS base layers (e.g., parcels, structures, roads, water bodies) and the vulnerability areas for earthquakes, coastal erosion, wildfires, landslides, and tsunamis were changed in order to incorporate new information.

The mitigation strategy for the 2007 MHMP was revised by incorporating mitigation activities begun and completed since 2004, editing the recommended mitigation measures and priorities, adding new funding sources, and revising the mitigation action plan to reflect progress and changes. Finally, the plan maintenance process was revised based on the experience of the MHMT. Table 2.1 summarizes the major changes made to each section of the 2004 MHMP as part of the 2007 MHMP update.

A meeting of the Lummi Nation Multi-Hazard Mitigation Team was held on January 24, 2007 to review and discuss each section of the plan. The MHMT meeting began with an overview of the purpose of and need for the plan and an overview of the update requirements. The MHMT then reviewed the implementation of the planning process since 2004, including the MHMT composition and meeting schedule, public involvement, data collection efforts, and agency coordination. The MHMT reviewed the hazard identification and vulnerability assessment by reviewing the events for each hazard since 2004 and reviewing the 2004 vulnerability assessment with consideration of changes in development, growth patterns, environmental conditions, and scientific information. Finally, the MHMT reviewed the mitigation strategy by verifying the goals and objectives, providing updates to the capability assessment based on new accomplishments, and editing the mitigation actions. As described previously, the plan was then presented at a joint meeting of the relevant LIBC commissions and at a regular meeting of the Lummi Indian Business Council for adoption by resolution.

Table 2.1 Summary of the Lummi Nation MHMP Changes (2004-2007)

Section	Changes
1. Introduction	<ul style="list-style-type: none"> • Edited to match changes to funding sources and goals and objectives. • Added Resolution No. 2007-060 adopting updated plan. • Added three new funding sources.
2. Planning Process	<ul style="list-style-type: none"> • Added a description of the steps taken to update the plan. • Updated the public participation process.
3. LIBC Adoption	<ul style="list-style-type: none"> • Described new development on the Reservation and • Updated population estimates. • Added new Lummi Nation zoning map and described major changes. • Updated emergency services information. • Added information on the casino expansions and casino and LIBC employment. • Described the in-process update to the 1999 wetlands inventory.

Table 2.1 Summary of the Lummi Nation MHMP Changes (2004-2007)

Section	Changes
4. Description of the Lummi Reservation	<ul style="list-style-type: none"> • Listed new documents used for hazard information. • Added description of methodology for making loss estimates. • Added new events for each hazard. • Incorporated new hazard information into the profile and vulnerability assessment for each hazard. • Updated loss estimate tables using 2004 structure counts, 2007 assessed values, and 2006 insurance values. • Added one hazard – tornadoes. • Refined vulnerability assessments for earthquakes, tsunamis, landslides, and coastal erosion based on new information. • Incorporated any reduced risk from undertaken mitigation activities.
5. Natural Hazard Risk Assessment	<ul style="list-style-type: none"> • Minor changes to goals and objectives. • Listed mitigation activities as they apply to each objective. • Included improvements to tribal capability such as revisions to LCL Title 15A and adoption of the Comprehensive Emergency Management Plan (CEMP). • Listed mitigation measures undertaken since 2004. • Edited proposed mitigation measures to reflect progress on projects and include new projects. • Edited mitigation priorities based on changes to mitigation measures. • Added three funding sources. • Updated the action plan to include new recommendations.
6. Local Mitigation Planning Coordination	<ul style="list-style-type: none"> • Described how the Natural Resources and Planning departments have provided local mitigation assistance. • Described the integration of new LIBC plans such as the Oil Spill Prevention and Response Plan and CEMP. • Described the MHMT's use of the prioritization criteria and ranking system.
7. Plan Maintenance Process	<ul style="list-style-type: none"> • Described the MHMT. • Compared the recommended update and monitoring processes to the actual processes and recommended changes for the next update.
8. Summary	<ul style="list-style-type: none"> • Minor edits.

2.4.2. 2010 Update

In 2010, the Multi-Hazard Mitigation Plan underwent a second update. Pursuant to the amendments to 44 CFR Part 201 at 72 Fed. Reg. 61720 published in October 2007, the classification of the plan changed from a State Multi-Hazard Mitigation Plan to a Tribal Multi-Hazard Mitigation Plan. The plan was updated according to the *Draft Tribal Multi-Hazard Mitigation Planning Guidance* published in July 2008 and the *Draft Crosswalk* published in January 2010. The Natural Resources Analyst participated in a training workshop in February 2010 hosted by FEMA Region X and the WEMD concerning risk assessment and the transition from a state-level to a tribal plan. Notable differences in requirements between the two types of plan included: (1) stronger emphasis in the tribal plan on the documentation of the planning process, (2) consideration of cultural resources in the vulnerability assessment and resulting mitigation actions, and (3) stronger involvement of the public and interested parties in the maintenance and update of the plan. To fulfill the first requirement, the planning process section of the 2010 MHMP was organized according to the new guidelines and information was added

where needed. The second requirement was addressed through a meeting with a representative of the Cultural Resources Department and subsequent consultations. Thirdly, input from the public and interested parties was solicited through a Squol Quol article and a notification letter mailed to businesses and public institutions on the Reservation. New sections were also added to the vulnerability assessment that provided an improved accounting of businesses and other parties on the Reservation, as well as discussion of cultural properties.

Hazard events during the update period were documented by collecting pertinent information from newspaper articles, websites, and agency notifications. The update was used as an opportunity to rethink the formatting and layout of the MHMP. For the sake of clarity, several redundant paragraphs were condensed, sub-headers added, and minor edits implemented without changes to the content of the text. All maps provided by the GIS Division were revised to reflect the most up-to-date information available for the Reservation. Buffer zones used in the loss calculations for the coastal erosion and landslide hazards were adjusted accordingly. Table 2.2 summarizes the major changes made to the 2010 MHMP.

A meeting of the Lummi Nation Multi-Hazard Mitigation Team was held on May 4, 2010 to review and discuss each section of the plan. The MHMT meeting began with an overview of the update requirements. The MHMT then reviewed the implementation of the planning process since 2007 including the MHMT composition and meeting schedule, public involvement, and data collection efforts. The MHMT reviewed the hazard identification and vulnerability assessment by reviewing the events for each hazard since 2007 and reviewing the updated 2010 vulnerability assessment with consideration of changes in data availability, regulations, and environmental conditions. Finally, the MHMT reviewed the mitigation strategy by verifying the goals and objectives, providing updates to the capability assessment based on new accomplishments, and reviewing the updated mitigation actions and adding new actions. The plan was then presented at successive meetings of relevant LIBC commissions and at a regular meeting of the Lummi Indian Business Council for adoption by resolution.

Table 2.2 Summary of the Lummi Nation MHMP Changes (2007-2010)

Section	Changes
1. Introduction	<ul style="list-style-type: none"> Removed the list of funding opportunities as this is repeated later in the plan. Moved the description of relevant Lummi Nation Code of Laws to the plan maintenance section.
2. Planning Process	<ul style="list-style-type: none"> Added a description of the steps taken to update the plan for 2010. Updated the public participation process. Rearranged the section to include a detailed plan preparation sub-section. Rewrote and updated the public participation process sub-section. Created the existing document review sub-section. Added 2010 update sub-section.
3. LIBC Adoption	<ul style="list-style-type: none"> Added this as a separate section. Updated the adoption for 2010.
4. Description of the Lummi Reservation	<ul style="list-style-type: none"> Added a description of the government structure of the Lummi Nation. Removed previous maps (Figure 3.2 and Figure 3.3) and replaced them with the Figure 4.2 – Land Cover/Land Use on the Reservation. Updated Table 4.1 and associated text.

Table 2.2 Summary of the Lummi Nation MHMP Changes (2007-2010)

Section	Changes
	<ul style="list-style-type: none"> • Updated emergency services information. • Updated socio-economic conditions. • Updated employment figures for the LCC. • Updated progress report on the wetland inventory effort. • Added description of the Lummi Nation Wetland and Habitat Mitigation Bank.
5. Natural Hazard Risk Assessment	<ul style="list-style-type: none"> • Added detailed descriptions of the hazard assessment areas. • Added two graphs. • Split table (formerly Table 4.23) into two new tables. • Added one map to flood vulnerability description. • Updated and rearranged hazards information. • Updated the individual hazard profile descriptions with events that occurred since the last update. • Added section on climate change. • Updated maps and losses to reflect FEMA FIRM maps for flood and windstorm vulnerability. • Updated tsunami map and losses to better reflect modeled tsunami inundation. • Updated coastal erosion and landslide map and losses with new calculation. • Updated the combined hazards map to reflect above changes.
6. Mitigation Strategy	<ul style="list-style-type: none"> • Moved the capability assessment to the end of the section after the mitigation actions to follow the guideline layout. • Changed the numbering system for the proposed mitigation actions from differentiating between long-term and short-term actions to a consecutive numbering system with a prefix for each hazard (e.g., FA=Flood Action; LSA=Landslide Action). • Moved all proposed actions for each hazard to the start of the respective section and listed them in tables. • Moved mitigation actions that were completed in the last 3 year interval into the respective current mitigation actions subsections. • Updated ongoing mitigation actions. • Added AH15, AH16, AH17, AH18, CEA3, and TA2. • Updated the summary table. • Updated the priority flood mitigation action map. • Changed the tribal and local capability assessment to a tribal capability assessment (as the tribal plan does not differentiate local jurisdictions as in a state plan) – previous information was integrated into the updated section.
Local Mitigation Planning Coordination	<ul style="list-style-type: none"> • This section is defunct in the new tribal plan – pertinent information was moved into the sections on tribal capability assessment and the plan maintenance process.
7. Plan Maintenance Process	<ul style="list-style-type: none"> • Updated the sections on monitoring, evaluating, and updating the plan and monitoring progress of mitigation actions. • Added a section on integration with existing plans with information formerly from the introduction.
8. Conclusion	<ul style="list-style-type: none"> • Rewritten; integrated the original text into the executive summary and the mitigation strategy description.
9. References	<ul style="list-style-type: none"> • Updated references as needed.

2.4.3. 2015 Update

The third update to the Lummi Nation Multi-Hazard Mitigation Plan was completed pursuant to the requirements of 44 CFR Part 201 as amended in 2007 and direction provided by the *Tribal Multi-Hazard Mitigation Planning Guidance* published by FEMA in March 2010. There were no changes to the FEMA requirements for Tribal Multi-Hazard Mitigation Plans between 2010 and 2015. During the 2010-2015 period, the Natural Resources Analyst maintained files documenting the occurrence of natural hazards and related events relevant to the Reservation and Lummi Nation MHMP. Information pertaining to these events was collected from a variety of sources, including peer-reviewed literature, newspaper articles, websites, agency notifications, and others. Newer and more accurate information about the Reservation population, socioeconomic conditions, and natural resources also became available over the 2010-2015 period; the text, figures, and tables of MHMP were updated accordingly. Table 2.3 summarizes the major changes made to the different sections of the 2010 version of the plan.

A meeting of the Lummi Nation Multi-Hazard Mitigation Team (MHMT) was held on August 20, 2015 to review and discuss the MHMP update. The MHMT reviewed the implementation of the planning process since 2010, including the MHMT member composition and meeting schedule, public involvement, and data collection efforts. The MHMT reviewed the hazard identification and vulnerability assessment by reviewing the events for each hazard since 2010 and reviewing the updated 2015 vulnerability assessment with consideration of changes in data availability, regulations, and environmental conditions. Finally, the MHMT reviewed the mitigation strategy by verifying the goals and objectives, providing updates to the capability assessment based on new accomplishments, and reviewing the updated mitigation actions. The plan was then presented at a regular meeting of the Lummi Indian Business Council for adoption by resolution.

Table 2.3 Summary of the Lummi Nation MHMP Changes (2010-2015)

Section	Changes
1. Introduction	<ul style="list-style-type: none">• Minor edits and revisions throughout.
2. Planning Process	<ul style="list-style-type: none">• Minor edits and revisions throughout.• Added Section 2.1.3 – Plan Preparation 2015 Update and Section 2.4.3 – 2015 Update.
3. LIBC Adoption	<ul style="list-style-type: none">• Added the 2015 MHMP adoption information.
4. Description of the Lummi Reservation	<ul style="list-style-type: none">• Minor edits and revisions throughout.• Updated section on current land use, including household numbers, opening of new Tribal Administration Building, as well as households and zoning maps.• Added Section 4.2.4 – Population and updated population statistics.• Updated section on socioeconomic conditions, including the current Portage Bay shellfish closure and the Silver Reef Hotel, Casino & Spa Phase V, VI, and VII expansions.• Updated information on utility providers.• Updated emergency response capabilities for fire and police.• Added paragraph on average air temperatures to the section on climate.• Updated descriptions and/or maps of aquifers, watersheds, wetlands, and estuaries to reflect new data.

Table 2.3 Summary of the Lummi Nation MHMP Changes (2010-2015)

Section	Changes
	<ul style="list-style-type: none"> Deleted section titled “Storm Water Runoff” and incorporated relevant information into other sections.
5. Natural Hazard Risk Assessment	<ul style="list-style-type: none"> Minor edits and revisions throughout. Renamed, reorganized, and updated Section 5.1 – Assessment Areas. Updated description of methodology for making loss estimates. Updated Table 5.1, including adding information from Table 5.2 (Table 5.2 subsequently deleted) and expanding the list of identified critical facilities. Updated map of critical facilities. Deleted two figures (previously Figure 5.3 and Figure 5.4), relevant information was incorporated into the text. Promoted “Cultural Resources” to a higher level heading (now Section 5.2). Updated text and tables with 2010-2015 occurrences of floods, earthquakes, severe winter storms, windstorms, coastal erosion, drought, wildfires, landslides, tsunamis, volcanic events, and tornados and updated potential losses, as appropriate. Added figure showing current levee protection levels along the lower Nooksack River. Added definitions to section on FEMA flood zones. Added two new figures showing recently identified faults on and near the Reservation. Rewrote Section 5.15 – Hazard Risk Assessment and Climate Change.
6. Mitigation Strategy	<ul style="list-style-type: none"> Minor edits and revisions throughout. Moved mitigation actions that were started and/or completed between 2010 and 2015 into the respective section on current mitigation actions. Updated ongoing mitigation actions. Updated Table 6.11 summarizing the recommended mitigation actions and priorities. Updated the flood mitigation priorities map.
7. Plan Maintenance Process	<ul style="list-style-type: none"> Minor edits and revisions throughout. Added Section 7.2.4 – 2015 Update Process, Section 7.2.5 – Planned Update Process 2015 through 2020, Section 7.3.4 – 2015 Monitoring Process, and Section 7.3.5 – 2015 through 2020 Monitoring Process. Added new and updated plans to the section on MHMP integration with existing plans.
8. Conclusion	<ul style="list-style-type: none"> Minor edits and revisions throughout.
9. References	<ul style="list-style-type: none"> Updated references as needed.

3. LIBC ADOPTION

The Lummi Indian Business Council (LIBC), the governing body of the Lummi Nation, passed Resolution No. 2004-015 on January 19, 2004, to formally adopt the 2004 version of this MHMP. FEMA approved the initial version of the Lummi Nation MHMP on May 4, 2004. The LIBC passed Resolution No. 2007-060 on April 17, 2007 to formally adopt the first three-year update of the plan. FEMA approved the 2007 Lummi Nation MHMP update on May 30, 2007. On May 25, 2010, the LIBC passed Resolution No. 2010-093 formally adopting the second three-year update of the plan. FEMA approved the 2010 Lummi Nation MHMP update on July 20, 2010. The LIBC passed Resolution No. 2015-107 on September 1, 2015 to formally adopt the third update of the plan, which was the first five-year update. FEMA approved the 2015 Lummi Nation MHMP update on November 2, 2015. All four resolutions are attached in Appendix A.

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4. DESCRIPTION OF THE LUMMI RESERVATION

The Lummi Indian Reservation (Reservation) is located in northwest Washington State, approximately eight miles west of Bellingham, Washington (Figure 4.1). The Reservation is located along the western border of Whatcom County and at the southern extent of Georgia Strait and the northern extent of Puget Sound. Approximately 38 miles of highly productive marine shoreline surround the Reservation uplands on all but the north and northeast borders. The Reservation includes approximately 12,500 acres of uplands and 7,000 acres of tidelands. The Nooksack River drains a watershed of approximately 786 square miles, flows through the Reservation near the mouth of the river, and discharges to Bellingham Bay (and partially to Lummi Bay during high flows). The Reservation is comprised of a five-mile long peninsula (Lummi Peninsula), which separates Lummi Bay on the west and Bellingham Bay on the east; a northern upland area (Northwest Uplands) and the smaller Sandy Point peninsula that separates Georgia Strait on the west and Lummi Bay on the east; the floodplains and deltas of the Lummi River and the Nooksack River; Portage Island; and associated tidelands.

The land uses, topography, climate, hydrogeology, soils, watersheds, and surface water resources on the Reservation affect the vulnerability of the Reservation to natural hazards. The remainder of this section briefly describes each of these elements, as well as the Lummi Nation's government structure and the socioeconomic conditions of the Reservation. More detailed descriptions can be found in the following reports: Lummi Nation Wellhead Protection Plan (LWRD 2011b); Lummi Reservation Storm Water Management Program Technical Background Document (LWRD 2011a); Lummi Indian Reservation Wetland Management Program Technical Background Document (LWRD 2000a); and the Lummi Nation Nonpoint Source Assessment Report (LWRD 2001b).

4.1. Lummi Nation Government

The Lummi Nation is a signatory of the 1855 Treaty of Point Elliot, and is a federally recognized sovereign Indian Tribe organized pursuant to an order approved on November 13, 1947 by the Acting Commissioner of Indian Affairs. The Lummi Nation is governed by an elected 11-member council, the Lummi Indian Business Council (LIBC), and the General Council, which consists of all enrolled tribal members of voting age (18 years old). The LIBC is supported by several administrative departments including Planning and Public Works, Economic Development, Police, Office of the Reservation Attorney, Cultural Resources, and Natural Resources. The Lummi Nation was one of ten tribes that initiated the Self-Government Demonstration Project in 1988 and maintains an independent Tribal Court system. Additional information regarding the Lummi government can be obtained from the tribal website (www.lummi-nsn.gov).

4.2. Land Use and Socioeconomic Conditions

Like most places, land use changes on the Reservation have been associated with changes in vegetation types, decreases in the areas covered by vegetation, changes in natural drainage patterns, and increases in impervious surfaces. With the arrival of Euro-Americans, forested

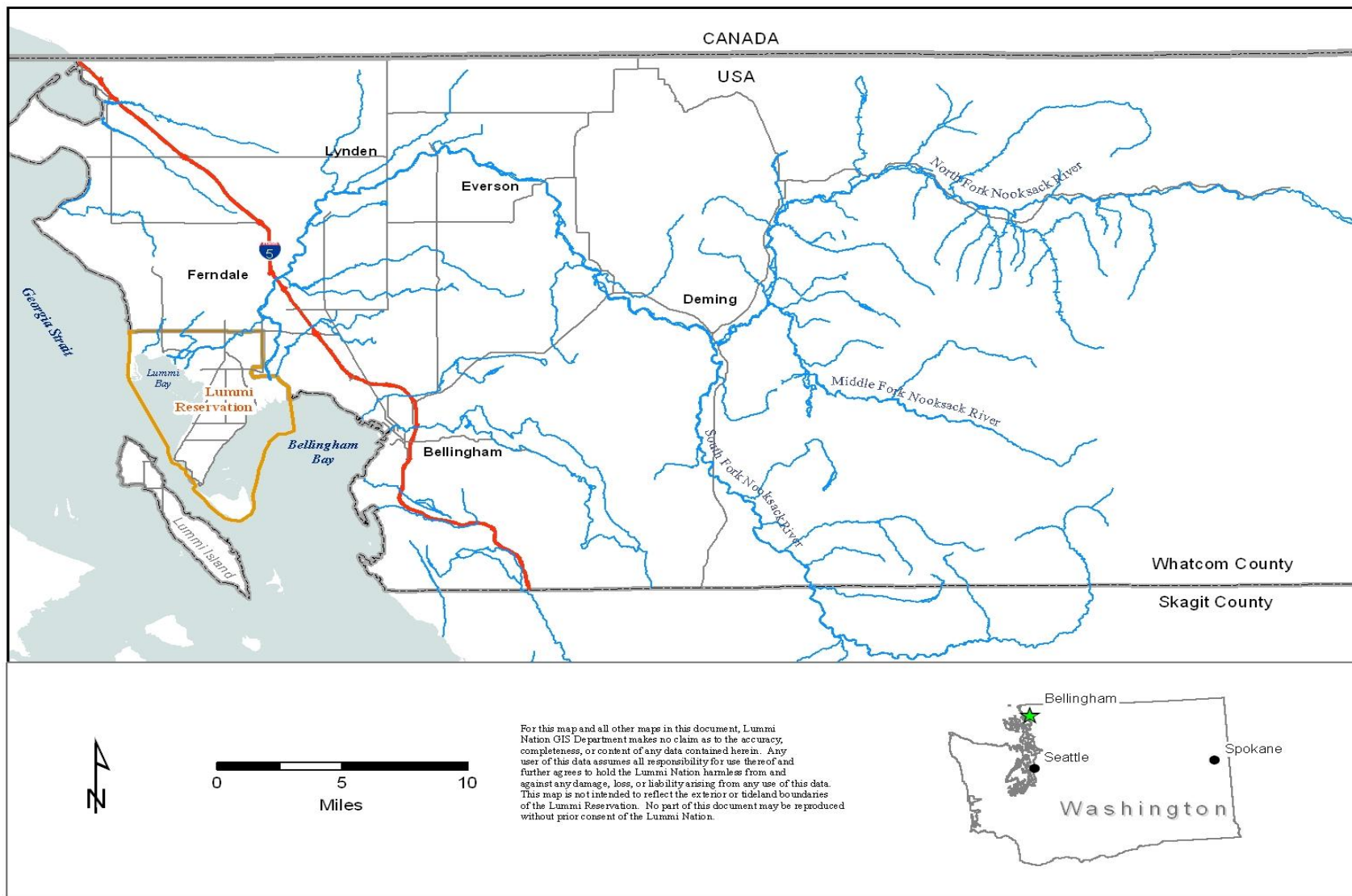


Figure 4.1 Regional Location of the Lummi Nation Reservation

land was logged, cleared, and drained for agriculture development, homes, municipal development, and commercial enterprises. Historic and current land uses in the Reservation watersheds and socioeconomic conditions on the Reservation are described below. Much of the information about historic land uses and socioeconomic conditions comes from the *Lummi Nation Comprehensive Environmental Land Use Plan: Background Document* (LIBC 1996).

4.2.1. Historical Land Use

Before the arrival of Euro-Americans, the Lummi People were a fishing, hunting, and gathering society. Based on the accounts of Lummi Elders, early European explorers, and early photographs of the region, before 1850 old-growth forests of massive Douglas fir, western hemlock, Sitka spruce, and western red cedar dominated what was to become the Lummi Indian Reservation. Deciduous trees such as western big leaf maple, black cottonwood, red alder, and western paper birch were also likely present along the rivers, streams, and open areas. Understory vegetation probably included vine maple, Oregon grape, several different willows, ocean spray, salmon berry, thimbleberry, soapberry, and many others. Wetlands, streams, and rivers supported a unique array of plants adapted to wet environments. The marine shoreline was also a unique environment, where only plants adapted to a saltwater-influenced environment thrived.

The forces that shaped vegetation patterns in the Northwest before the arrival of Euro-Americans were forest succession, fires, windstorms, ice storms, floods, and traditional use of natural vegetation by the indigenous peoples. Native American uses of vegetation included the gathering of medicinal plants, the use of willows and other shrubs for fishing, and the extensive use of western red cedar trees for many things, including clothing, baskets, buildings, and canoes. Many plants were also sources of food to complement the traditional diet of fish, shellfish, elk, and deer. Native Americans cultivated some of these plants, such as ferns, camas, and wapato, in prairies along the Nooksack River.

Similar to most areas in the lower Nooksack River watershed downstream from Everson, conversion of forestland to agricultural land occurred on the Lummi Indian Reservation following the arrival of Euro-Americans. In 1896, approximately 1,222 acres were reportedly under cultivation on the Reservation. Along with clearing the forested land for agriculture, Euro-Americans constructed ditches, drained wetland areas, cleared logjams, diverted the Nooksack River to drain into Bellingham Bay, built a levee that cut off the Lummi River delta from the Nooksack River, and built a seawall along Lummi Bay. These changes in the natural hydrology of the Lummi Reservation changed the distribution and patterns of watercourses and of wetland- and riparian-associated plant communities.

Much of the cedar on the Reservation was cut into shingle bolts and shipped to local shingle mills. The old-growth trees on Portage Island were cut down to fuel steamboats traveling the Nooksack River. One or more large fires swept through the Reservation area between 1850 and 1900. These fires destroyed nearly all of the remaining old-growth forests. Since reforestation was not practiced during the early logging period and did not begin until approximately 1980, pioneer tree species, such as alder, willows, and cottonwood, soon replaced the conifer forests and dominated the landscape (Leckman 1990).

Historically, the Nooksack River flowed (alternately or simultaneously) to both Lummi and Bellingham bays (effectively making the Lummi Peninsula an “island”). Before 1860, the Nooksack River discharged primarily into Lummi Bay by way of the present Lummi River channel, with smaller distributaries flowing into Bellingham Bay (WSDC 1960; Deardorff 1992). In 1860, the mainstem of the river was diverted into what was then a small stream flowing into Bellingham Bay (WSDC 1960). Since that time, considerable effort has been expended to keep the Nooksack River discharging into Bellingham Bay because of the increased commercial value of the river that resulted from its proximity to sawmills along Bellingham Bay (Deardorff 1992). Until the early 1900s, the Nooksack River was also the primary transportation corridor to as far upstream as present day Lynden. The water body remaining in the old channel of the Nooksack River has been called the Lummi River or the Red River (WSDC 1960).

In the 1920s, a reclamation project was initiated both to construct a dike/seawall to keep back the saltwater along the shore of Lummi Bay and to construct a levee along the west side of the Nooksack River (Deardorff 1992). This project, which was started in 1926 and completed in 1934, initially resulted in the nearly complete separation of the Lummi River from the Nooksack River. However, when saltwater intrusion onto the newly reclaimed farmlands and damage to the dam at the head of the Lummi River occurred during flooding, the dam was replaced with a dam and spillway structure (Deardorff 1992). This spillway structure was also damaged over the years during high-flow conditions and was replaced in 1951 by a five-foot-diameter culvert that allowed flow from the Nooksack River into the Lummi River (FEMA 2004a). Currently a partially collapsed four-foot diameter culvert allows flow to the Lummi River only during relatively high-flow conditions (approximately 9,600 cfs) (Deardorff 1992). Levees were also constructed along the Lummi River to prevent saltwater from Lummi Bay from flowing onto adjacent farmlands during higher tides. The dike and levee construction activities were accompanied by agricultural ditching to drain fields and wetland areas. Based on 1887-88 topographic surveys, Bortleson et al. (1980) estimated that wetlands located landward of the general saltwater shoreline in the lower Lummi River watershed have decreased from approximately 2.0 square miles to 0.1 square miles (approximately 95 percent) over the 1888-1973 period.

Between 1920 and 1960 several new public roads providing access to Ferndale and Bellingham as well as a toll ferry to Lummi Island were constructed and led to an increase in development on the Reservation. Since 1960 there has been a significant increase in the total population on the Reservation and the number of tribal members living on the Reservation. The increase in the number of enrolled Lummi tribal members living on the Reservation has been attributed to a number of factors including improved economic conditions within the community, the beginning of tribal self-governance, the increased rate of house construction, the development of a water distribution and a wastewater collection and treatment system, and a renewed sense of Lummi cultural identity.

4.2.2. Current Land Use

An approximation of the current land cover and land use in the Reservation watersheds is shown in Figure 4.2. This map was derived from the 2006 National Oceanic and Atmospheric Administration (NOAA) database, Classification of Coastal Washington, which is part of the Coastal Change Analysis Program (C-CAP) of the NOAA Coastal Services Center (NOAA

2006). The map gives an overview of the extent of forest and agricultural lands, residential areas, and wetlands in these watersheds. The estimated distribution of land cover/land use types within the Reservation boundaries is summarized in Table 4.1.

The majority of the forested areas are on the Lummi Peninsula, Portage Island, and the Northwest Uplands. Although there are some conifer groves and Douglas fir plantations, the 2007 inventory of Reservation forests showed that present day forests are largely comprised of deciduous trees, with some mixed deciduous/conifer stands (International Forestry Consultants, Inc. 2007). Wetlands are underrepresented on the C-CAP map, as the remote sensing analysis did not recognize big swathes of forested and scrub-shrub wetlands, but counted them towards forests and scrub-shrub. Based on the 1999 Reservation-wide wetland inventory (LWRD 2000), the percentage of the Reservation land base that is wetland is closer to 40 percent than the 3.46 percent listed in Table 4.1.

The floodplains of the Lummi and Nooksack Rivers are sparsely developed. The relatively few homes that are located in floodplain are on agricultural properties and were constructed before 1950. The most important commercial enterprise in the floodplains is the Silver Reef Hotel, Casino & Spa and the adjacent gas station and mini-mart. This commercial center is located at the intersection of Haxton Way and Slater Road. The floodplains are dominated by agricultural lands and wetlands, both freshwater and estuarine.

Over the last century, the increase in population, the construction of extensive road networks, development of wastewater collection and treatment systems, the construction of the Sandy Point Marina, and several tribal housing projects have fostered a trend towards higher density neighborhoods throughout the Reservation. Several distinct residential neighborhoods now exist, mainly along the shores of the Reservation including Sandy Point, Neptune Beach, Sandy Point Heights, and Gooseberry Point. Higher density residential neighborhoods can also be accessed from the numerous spur roads along Haxton Way and Lummi Shore Road, which are the primary roads along the perimeter of the Lummi Peninsula. Figure 4.3 shows the distribution of households in 1910, 1950, 1976, and 2013. Many of the more expensive homes on the Reservation are located in the coastal flood zones along the Sandy Point Peninsula, Neptune Beach, Gooseberry Point, and Hermosa Beach shorelines. Most of these houses were constructed after 1960, including significant new construction and additions in the past two decades. The 2010 Census found 1,989 housing units on the Reservation, of which 1,632 (82 percent) were occupied year-round.

Tribal governmental services have also become more centralized, particularly following the opening of the Lummi Nation Administration Center along Kwina Road in 2013. Other government services (e.g., Health Clinic, Fitness Center) and the Northwest Indian College (NWIC) are also located along Kwina Road. Although increased development has occurred on the Reservation in the last few decades, the majority of the Reservation remains rural.

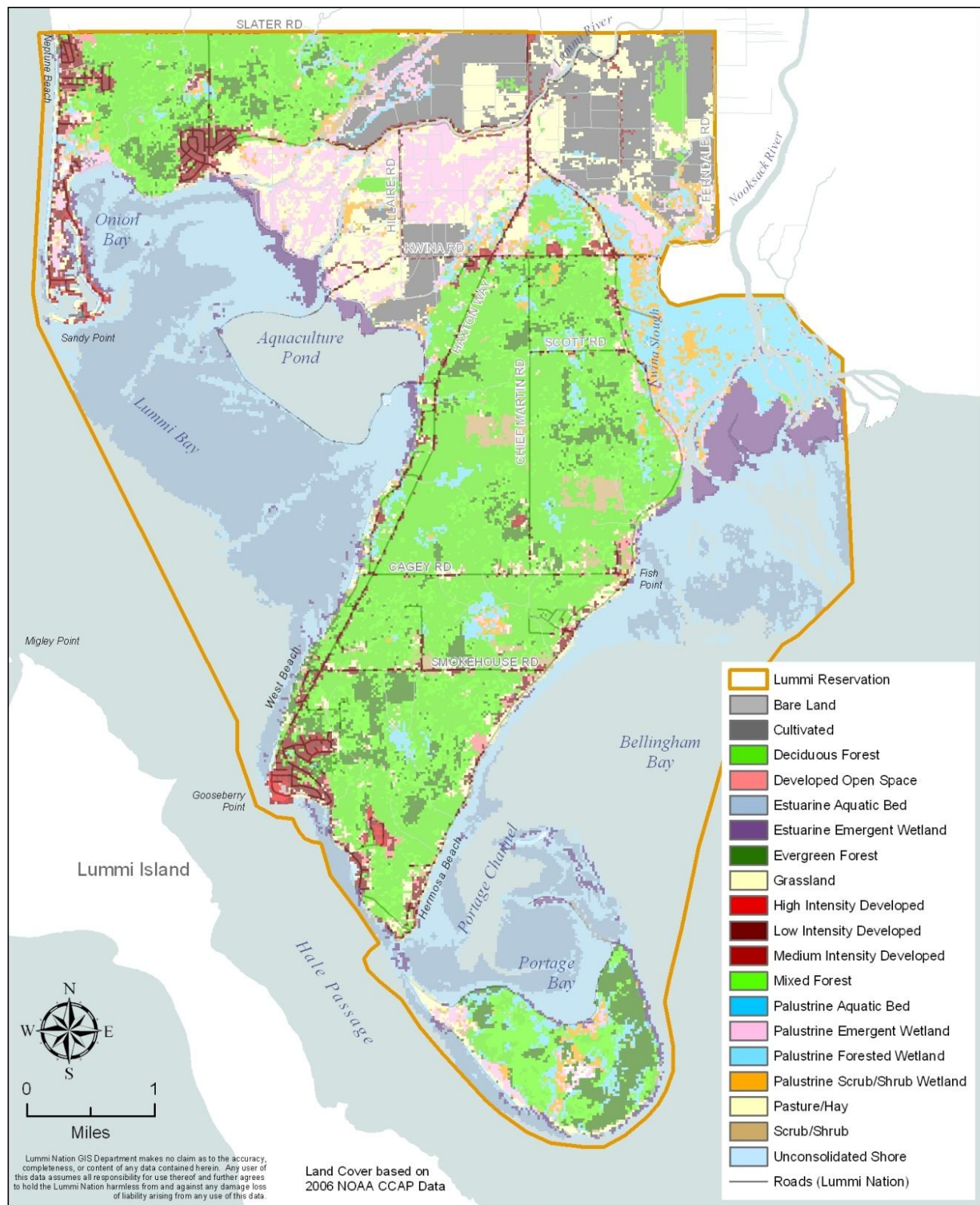


Figure 4.2 Upland Use/Land Cover on the Lummi Reservation derived from NOAA C-CAP 2006

Table 4.1 Current Land-Cover/Land-Use Types on the Lummi Reservation¹ based on 2006 C-CAP mapping

Land Cover/Land Use	Percent of Area ¹
Residential	2.59
Forest	20.88
Scrub-Shrub	47.79
Wetlands	3.46
Cultivated Land/Grassland	25.28

¹ Does not include the Nooksack River watershed (off-Reservation) or tribal tidelands

Based on estimates of land cover in Whatcom County, land cover/use in the Nooksack River watershed is generally dominated by forested areas upstream from the town of Deming and agricultural lands downstream from Deming (Whatcom County 2005). The agricultural lands in the lowlands were largely forested before the arrival of Euro-Americans and had been largely denuded of trees by 1925 (Pierson 1953, as cited in Smelser 1970). Population centers such as Ferndale, Lynden, Everson, and Deming are located adjacent to the Nooksack River.

4.2.3. Future Land Use

Future development on the Reservation is guided by a number of tribal laws (Lummi Nation Code of Laws [LCL]) and associated regulations including:

- LCL Title 15: Land Use, Zoning, and Development Code
- LCL Title 15A: Flood Damage Prevention Code (Appendix D)
- LCL Title 16: Sewer and Water District Code
- LCL Title 17: Water Resources Protection Code
- LCL Title 22: Building Code
- LCL Title 40: Cultural Resources Preservation Code

Figure 4.4 shows the current official zoning map of the Lummi Reservation. This zoning map was revised and adopted by the LIBC in 2004 as part of the comprehensive planning effort currently underway by the Planning and Public Works Department. The zoning update incorporated comments from tribal departments and commissions and from public comments received during four community meetings.

The Lummi Planning and Public Works Department is developing a Comprehensive Plan for the Lummi Reservation. The plan will show, in general, how land on the Reservation will be used over the next 20 years. The Comprehensive Plan will identify areas that will be developed for residential, commercial, mixed uses, industrial, and agricultural purposes, as well as show areas that require protection (e.g., Special Flood Hazard Areas, wetlands, and aquifer recharge zones). To date, a technical background document (LIBC 1996) has been developed, public opinion surveys conducted, drafts of the Comprehensive Plan and maps developed, and focused planning

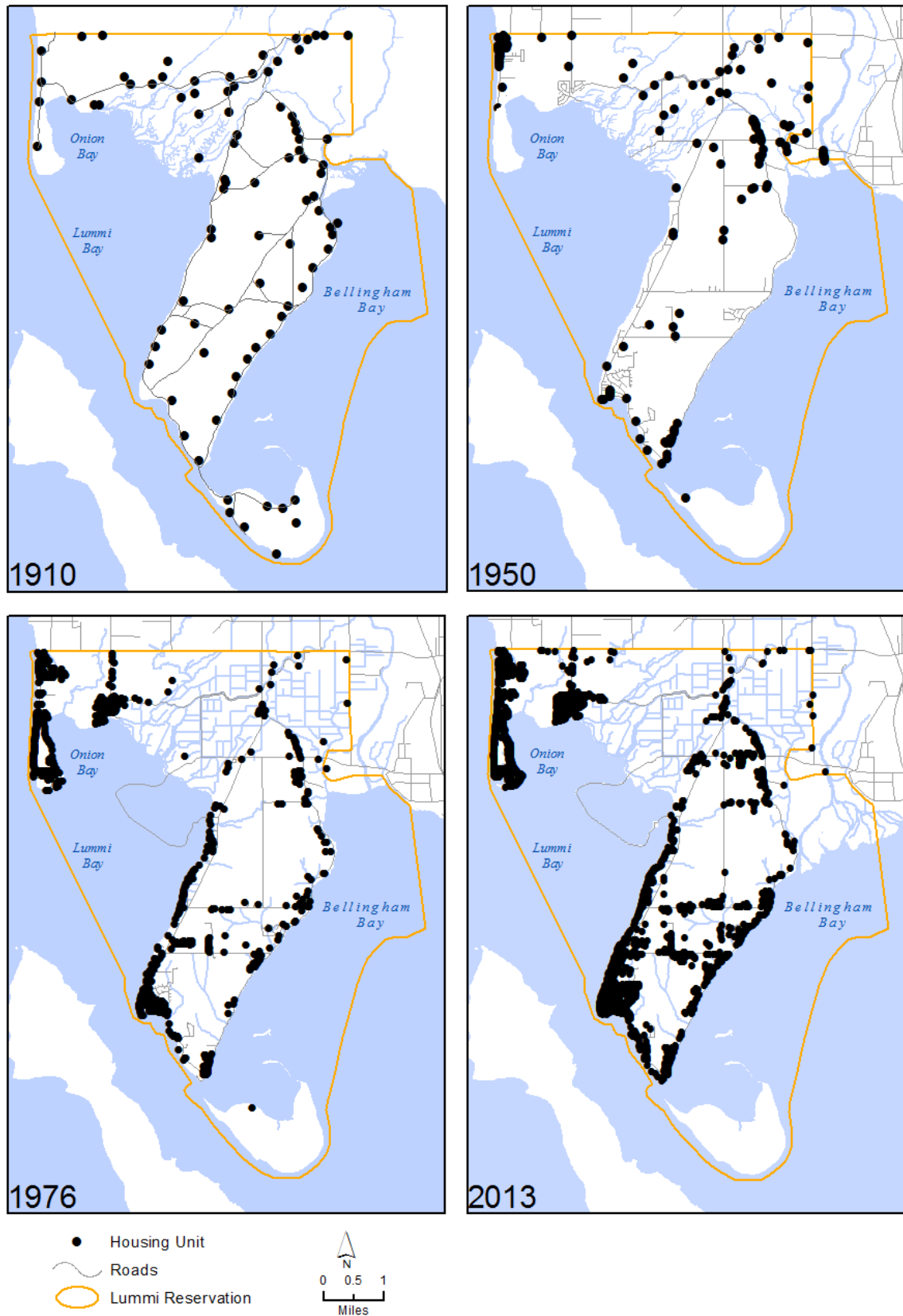


Figure 4.3 Households on the Lummi Reservation, 1910-2013

workshops and meetings with commissions and community groups have occurred. The Comprehensive Plan is codified in LCL Title 15 (Land Use, Development, and Zoning Code). Title 15 also formalized an environmental review process that had been already largely in place since 1997 pursuant to LIBC resolutions.

4.2.4. Population

According to the 2010 Census, a total of 4,706 people lived on the Reservation during 2010, which is an 11 percent increase from the 2000 Census population of 4,193. In the 2010 Census, 2,643 people (56.2 percent) identified themselves as American Indian and Alaska Native (Indian) alone or in combination with other races. Corrected by the 2010 undercount rate (4.9 percent), approximately 2,772 American Indians or Alaska Natives are currently living on the Reservation. Population projections from a 2003 study by Northwest Economic Associates suggest that the number of American Indians living on the Reservation would increase from 2,346 persons in 2000 to 3,767 persons in 2020 and to 15,451 persons in 2100. Including the non-Indian population, which was predicted to grow at a slower rate, the Reservation population is estimated to reach 5,800-6,800 persons by 2020. In 2011, the Lummi Enrollment Office reported that there were approximately 4,650 enrolled Lummi tribal members living on- and off-Reservation (Kamkoff 2011).

4.2.5. Socioeconomic Conditions

Fishing, logging, farming, and other natural resource work have historically provided most of the jobs for Lummi tribal members. Until the 1974 Boldt Decision, Lummi tribal members were systematically precluded from the profitable salmon fishery in Puget Sound. Once the treaty fishing right was upheld by the U.S. Supreme Court, commercial fishing and fish processing began to expand on the Reservation resulting in increasing numbers of fishermen, fish processing, and increased overall tribal revenue from the salmon fisheries.

The Lummi Nation is the largest fishing tribe in the Puget Sound in terms of pounds of fish landed and number of species fished (NWIFC 2012). However, the recent declines in salmon stocks have dramatically altered the tribal reliance on salmon fishing as an economic mainstay. In 1985, the average Lummi fisherman made \$22,796 (\$49,000 in 2011 dollars). In 1993, the average income from fishing was only \$5,555 (\$8,500 in 2011 dollars). During this period, about 30 percent of the tribal work force relied on fishing for their sole source of income (LIBC 1996). In the 10 year period between 1995 and 2005, there were an average of 592 fishing registrations and 126 crabbing registrations each year. During the 2012-2013 harvest management year (July 1 – June 30) there were 404 vessels registered with the Lummi Nation.

Over the last 15 years, the crab fishery has provided the largest percentage of the yearly fishery revenue followed by sockeye salmon and manila clams. Since 1993, further reductions in salmon stocks have resulted in closure of some fisheries and a further reduction in tribal fishery incomes (LIBC 1996). During 1999, 2007, 2009, and 2013 the sockeye salmon fishery was closed entirely due to low fish runs. The loss or reduction of a fishery increases the importance of the other fisheries to the Lummi economy. Although there are annual variations, 2001 is representative of the most recent 10 years. In 1985, the Lummi Fishing Fleet landed about 15.3 million pounds of finfish and shellfish. In 2001, the combined harvest was about 3.9 million pounds of finfish and shellfish.

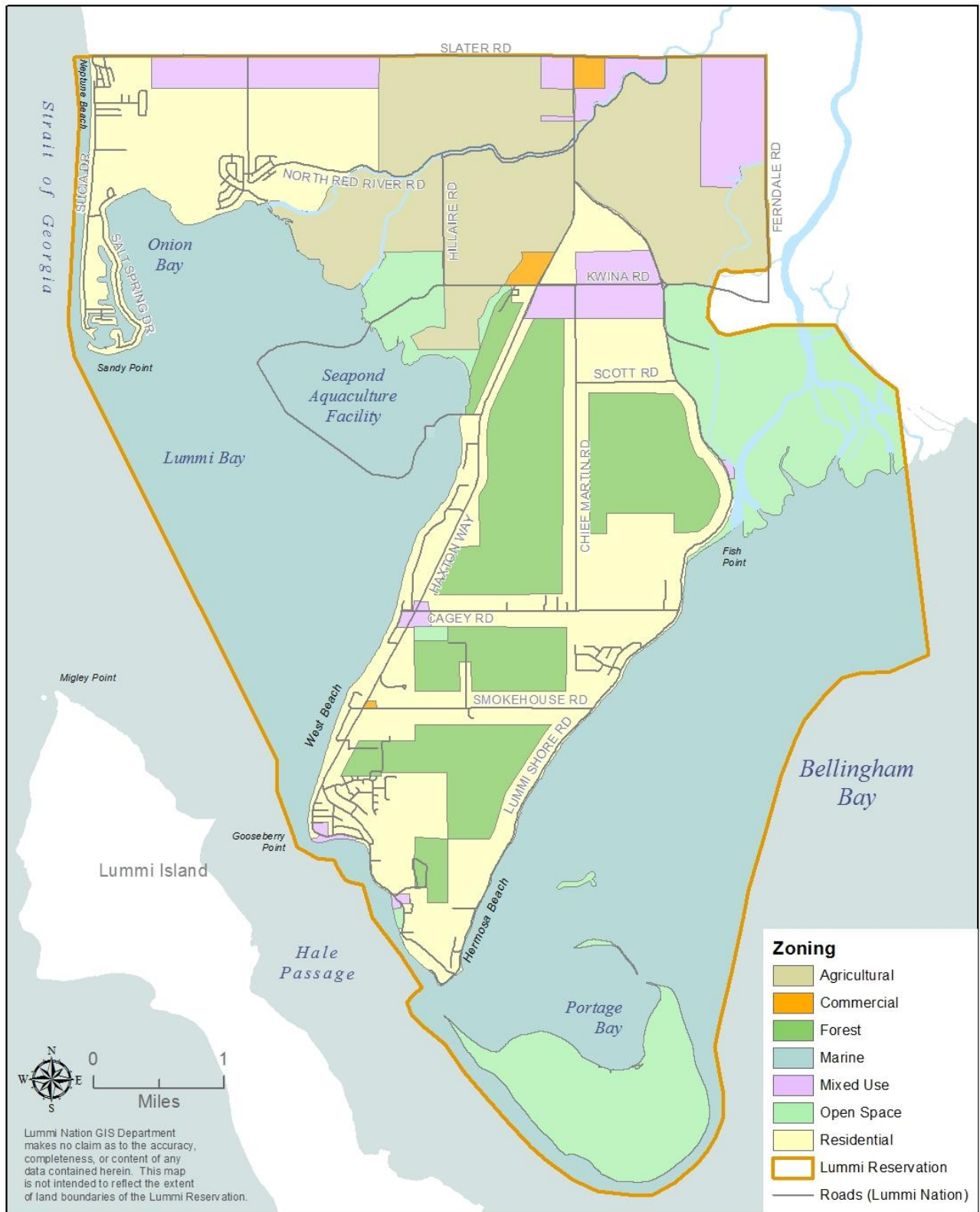


Figure 4.4 Current Land Use Zones on the Lummi Reservation

In addition to catching fish and harvesting shellfish, the Lummi Nation owns and operates three salmon hatchery facilities, one of which is located off-Reservation. These facilities produce millions of young salmon each year and help offset the decline of fish stocks due to loss of natural habitat and historic over-fishing. The tribe also owns an on-Reservation shellfish hatchery, producing over one billion oyster and clam seeds annually. The tribe owns 7,000 acres of tidelands, much of which is suitable for productive shellfish beds (LIBC 1996). All of these tidelands are held in trust by the United States for the exclusive use of the Lummi Nation.

The tribal commercial shellfish enterprise and the commercial, subsistence, and ceremonial harvest of shellfish by the Lummi Nation and individual tribal members was severely impacted by the closure of 60 acres of tidelands in 1996 and 120 additional acres in 1997. These closures occurred in Portage Bay and were largely attributed to poor dairy waste management practices in the Nooksack River watershed (DOH 1997). Not considering the multiplier effects on the economy, the lost value of the shellfish products alone was estimated to be approximately \$825,000 per year. In response to the 1996 closure, the EPA conducted compliance enforcement inspections of dairy operations in the Nooksack River watershed starting in 1997, the State of Washington passed the 1998 Dairy Nutrient Management Act (RCW 90.64), and dairy farmers developed and implemented nutrient management plans (a.k.a. farm plans). As a result of these reactions and additional compliance inspections by the Washington State Department of Ecology (Ecology), water quality in the Nooksack River improved. In November 2003, approximately 75 percent of the previously closed shellfish beds in Portage Bay were reopened to commercial harvest. In May 2006, the remaining closed shellfish growing areas were reclassified as “approved” for harvest.

Although Nooksack River water quality improved dramatically during the 1997 through 2004 period and resulted in the re-opening of the shellfish beds in 2006, deteriorating water quality trends started to become apparent again in 2005. Despite efforts to proactively prevent another shellfish bed closure due to poor water quality, portions of the Portage Bay shellfish beds no longer achieved the National Shellfish Sanitation Program (NSSP) standards during 2014. In order to protect public health, the Lummi Nation voluntarily closed 335 acres of shellfish growing areas to harvest in September 2014. Continuing poor water quality over the growing area resulted in nearly 500 acres of shellfish bed being closed to harvest by the end of December 2014.

A Lummi Casino project began in 1983 in an effort to diversify the Reservation economy. The casino operation was upgraded significantly in 1994 with the opening of the Lummi Casino at Fisherman’s Cove. The casino flourished initially, employing approximately 400 people, 65 percent of whom were Native American (LIBC 1996). However, competition and changing economic conditions resulted in the closure of the casino on August 26, 1997. With 238 workers losing their jobs, the Lummi unemployment rate grew to approximately 50 percent.

A new casino opened in April 2002 at a new location (the corner of Haxton Way and Slater Road) closer to the Interstate 5 highway. The new casino (the Silver Reef Casino) initially was 28,000 square feet and employed approximately 200 people. The casino was expanded in 2004 (Phase II) to a total of 55,000 square feet with the addition of additional gaming space, a restaurant, and a 400 seat pavilion. The casino was expanded again in 2006 (Phase III) to 135,000 square feet with the addition of a restaurant, additional gaming space, a spa and fitness

room, and a six floor, 109 room hotel (NEI 2005). Following this expansion, the Silver Reef Casino was renamed the Silver Reef Hotel, Casino & Spa. A smaller expansion (Phase IV) of approximately 9,000 square feet occurred in 2008 to add gaming space and an additional restaurant. The Phase V expansion was additional parking only. The most recent expansion was completed in 2013 (Phase VI) and included the addition of 50,000 square feet of additional gaming area, a new restaurant, theater, and event center. A second hotel tower (Phase VII) is currently under construction and is expected to be completed during 2015. In 2005, after the first expansion, the casino employed 382 workers of which 274 were full-time employees and 108 were part-time employees (NEI 2005). In 2007, after the addition of the hotel and spa, the casino employed 500 people (Werner 2007). By 2010, the Silver Reef Hotel, Casino & Spa employed 550 people; following the opening of the Phase VI expansion in 2013 there were 675 employees. The LIBC operates a gas station and mini-mart adjacent to the Silver Reef Hotel, Casino & Spa.

Other employment opportunities for Reservation residents exist at the two oil refineries and the aluminum smelter just north of the Reservation and nearby in the communities of Ferndale and Bellingham. In 2004, 40.8 percent (131) of the 321 businesses licensed to operate on the Reservation were owned by enrolled tribal members (NEI 2005). These businesses included fireworks sales, food preparation and retail, wholesale, and trade businesses. In 2014, 408 businesses were licensed to operate on the Reservation according to the LIBC Accounting Department. Of these businesses, 144 were located on the Reservation and ranged from large employers (Silver Reef Hotel, Casino & Spa) to long established fish buying and processing enterprises, trades, native arts, and food catering. Additional details regarding businesses on the Reservation are presented in Section 5.1.

In 2013, the LIBC was the 9th largest employer in Whatcom County and the Silver Reef Hotel, Casino & Spa was the 14th largest employer; with all tribal institutions combined, the tribe is the 3rd largest employer in the county (WWU 2013). Most of the LIBC and Northwest Indian College (NWIC) employees are tribal members. In 2003, native employees made up 70 percent of LIBC staff (55 percent enrolled Lummi tribal members) and 61 percent of NWIC staff (33 percent enrolled Lummi tribal members) (Valz 2003). The LIBC provides community, administrative, education, natural and cultural resources protection, and health services to the tribal population in order to help achieve the tribal economic and social development goals. These goals include job creation for tribal members, income generation to fund community development programs, and diversification and stabilization of the local economy by creating alternatives to fishing. Revenue generation is needed in order for the Lummi Nation to develop economic self-sufficiency.

In 1993, 56 percent of the 2,500 working-age Lummi tribal members were unemployed, under employed, full-time students, or no longer seeking work (LIBC 1996). Since 1993, the combined effect of the decline in the fishery and the closure of the original casino have had a substantial negative impact on the Lummi economy. The BIA reported that the unemployment rate on the Reservation in 1999 was 21 percent (BIA 1999). Table 4.2 presents the results of a survey of 2,054, over the age of 18, enrolled tribal members conducted by the LIBC Statistics Office in 2003. This survey indicates that 28 percent of adult tribal members were unemployed and up to 14 percent may have been underemployed (part-time, seasonally employed) (LIBC 2003). In 2004, 74.6 percent of enrolled Lummi tribal members in Whatcom County ages 18 through 64 were employed and 15.9 percent were unemployed (NEI 2005).

Table 4.2 Employment Status of Lummi Tribal Members, 2003¹

Employment Status	Number in Status	Percentage of Surveyed Individuals
Employed full-time	825	40.2
Employed part-time	156	7.6
Employed seasonally	133	6.5
Self-employed	84	4.1
Retired	127	6.2
Unemployed	576	28.0
Not available for employment	153	7.4

¹2003 Lummi Tribal Survey, LIBC Statistics Office.

4.2.6. Utilities

Utility service on the Reservation is provided by Puget Sound Energy (electricity), Cascade Natural Gas (natural gas), the Lummi Tribal Sewer and Water District (water and sewer), and eight private water associations (water). Natural gas is currently available only to a limited area along the northern part of the Reservation (i.e., the Silver Reef Hotel, Casino & Spa and Lummi Mini Mart), but may become more widely available in the future. The majority of buildings on the Reservation are heated with electricity, propane, or wood. Collection services for solid waste and recyclable materials are offered to the residents and businesses of the Reservation by a private company (Sanitary Services Corporation). Residents may also opt to self-haul solid waste and recycling to off-Reservation transfer stations. Land line telephone service and internet service is available through a variety of providers (e.g., Verizon, Qwest, Comcast, San Juan Cable).

The Lummi Tribal Water District is the largest and most comprehensive water system on the Reservation. It relies primarily on Reservation groundwater from public supply wells, supplemented as necessary by water purchased under contract from the City of Bellingham. Eight small water systems operated by private, non-Indian water associations provide predominantly non-Indian residential areas with groundwater that is withdrawn from Reservation aquifers pursuant to Washington State water rights permits. The Lummi Nation's reserved water rights pre-date and are superior to any permits or water rights acquired from the state. A number of domestic wells belonging to individuals and small groups also supply residences under both tribal and state-claimed authority (LIBC 1996).

The Lummi Tribal Sewer District operates a comprehensive, Reservation-wide, wastewater collection and treatment system that serves the majority of households on the Reservation. The sewer facilities consist of sewer collectors, sewer interceptors, 27 pump stations, and three treatment plants (Wilson 2006, LIBC 1996). For residences not on a sewer line, the Sewer Code (LCL Title 16) regulates sewage disposal for public health and safety and establishes criteria for the design, construction, alteration, and operation of on-site septic systems. The Lummi Tribal Sewer District enforces the sewer code and inspects on-site septic systems. The Sewer Code serves to minimize pollution during flood events by ensuring that appropriate sanitary sewer facilities are used by Reservation residents and that systems are operated and maintained in a manner that protects public health.

Six of the sewer pump stations are within the Lummi and Nooksack river floodplains and eight are located in areas susceptible to coastal flooding events. These pump stations have been flood-proofed to minimize their susceptibility to flood damage. In the update interval from 2007 to 2010, generators were installed adjacent to each pump station to prevent spills in case of power outages (e.g., in the event of windstorms). Although some water and sewer lines cross the Nooksack River floodplain or the coastal flood areas, both wastewater treatment plants and all public water supply wells are outside of flood-prone areas. However, some hydraulic loading of wastewater facilities can occur during floods because of floodwater seepage into manholes in the floodplain.

4.2.7. Emergency Services

Three fire districts with primarily volunteer staff provide fire protection and emergency medical aid services on the Reservation. Whatcom County Fire District 8 covers the Reservation south of the Lummi River, including the Lummi Peninsula. The main District 8 station (No. 31, previously No. 1) is located on the intersection of Marine Drive and Bennett Drive on the outskirts of Bellingham, with an approximate response time of 7-8 minutes to the Kwina Road area (Tribal Administration Building, Tribal Health Clinic, and Northwest Indian College). The second District 8 Station (No. 34, previously No. 5) is located at Gooseberry Point along MacKenzie Road. Fire District 8 has a staff of 8 career and 30 volunteer firefighters. These firefighters work in shifts to ensure that there are 3 people on duty 24 hours a day 7 days a week at the District's two fire stations. Both stations have fire engines and medical aid vehicles.

Whatcom County Fire District 17 provides fire protection and emergency medical aid services to the Sandy Point Peninsula and Sandy Point Heights/Lake Terrell Road areas in the northwest portion of the Reservation. District 17 has two stations, one on the Sandy Point Peninsula (Station No. 1) and one at Sandy Point Heights (Station No. 2). Whatcom County Fire District 17 has a full-time career fire chief during the day and an on-call duty officer during nights and weekends, as well as 18 volunteer firefighters. Both stations operate a licensed medical aid unit. Station No. 1 lies within the coastal shallow flooding zone and had to be protected by sand bags during previous coastal flooding.

Whatcom County Fire District 7 has several stations in and around Ferndale and provides fire protection and medical aid services to the Slater Road area along the northern boundary of the Reservation, including the Silver Reef Hotel, Casino & Spa. The nearest Ferndale station is manned 24 hours per day 7 day per week by full-time career firefighters as well as volunteer responders.

The Lummi Nation Police Department provides public safety protection throughout the Reservation and works with the Federal Bureau of Investigation (FBI), the Washington State Patrol, the Whatcom County Sheriff's Department, and other law enforcement agencies as appropriate. Lummi Police has jurisdiction over all members of federally recognized tribes on the Reservation. The Whatcom County Sheriff's Department has jurisdiction when an offense is committed on the Reservation by a person who is not a member of a federally recognized tribe or if the offense is committed on non-member owned fee land. The FBI investigates major crimes that are committed on trust land or member-owned fee land by members of federally recognized tribes. The Lummi Nation Police Department is responsible for enforcement of the Lummi Nation Code of Laws. The department employs 1 police chief, 1 lieutenant, 3 patrol sergeants,

10 patrol officers, 4 detectives, 1 natural resources sergeant, 4 natural resources officers, and 2 civil administrative staff. All members of the force are certified by the State of Washington and the Bureau of Indian Affairs (BIA). The force has 13 patrol vehicles, 7 sports utility vehicles, 4 pickup trucks, 4 ATV's, 4 boats, 2 bikes, and 1 incident command vehicle. The Lummi Police Department is the first responder to all emergency calls on the Reservation and is responsible for emergency services on the Reservation in the case of flood, earthquake, or other natural disasters.

Lummi Police, in cooperation with the Whatcom County Division of Emergency Management (in the Whatcom County Sheriff's Department) and local fire and police agencies is trained and prepared to respond to minor spills or releases of some hazardous materials. Small quantities of hazardous materials are known to be used and transported through the Reservation on a regular basis. The most significant operations using hazardous materials are the two oil refineries and one aluminum smelter located just north of the Reservation. One of the main transportation routes to and from these operations is Slater Road, which is located along the northern boundary of the Reservation. In response to a major hazardous material spill on the Reservation or in Reservation waters, experts from the U.S. Environmental Protection Agency (EPA) and/or the United States Coast Guard (USCG) and local industries would be called in to help control the damage. The Lummi Nation Spill Prevention and Response Plan (SPRP), developed in 2005 by the Lummi Water Resources Division, further describes the spill response capabilities and responsibilities of these agencies. Through the recommendations of the SPRP, the Lummi Natural Resources Department formed the Lummi Nation Spill Response Team for response to oil spills to Reservation waters.

4.3. Topography

The Lummi Indian Reservation is comprised of two relatively large upland areas, a smaller upland area on Portage Island, and the two distinct lowland areas (the floodplains) of the Lummi and Nooksack rivers and the Sandy Point Peninsula. The maximum elevation of the northwestern upland area of the Reservation is about 216 feet above the North American Vertical Datum 1988 (ft NAVD88). The southern upland area is the Lummi Peninsula with a maximum elevation of about 178 ft NAVD88. The floodplain of the Lummi and Nooksack rivers, with an average elevation of approximately 10 ft NAVD88, lies between the northern and southern upland areas. The Nooksack River and the Nooksack River delta are located along the northeastern extent of the Reservation. The Sandy Point Peninsula lies to the southwest of the northwestern upland. Portage Island lies at the southeastern tip of the Lummi Peninsula and has a maximum elevation of approximately 209 feet NAVD88. Figure 4.5 displays these geographic locations, the topography, and the major roads on the Reservation.

The upland and lowland areas of the Reservation total about 12,500 acres; the associated Reservation tidelands total approximately 7,000 acres. Individual tribal members or the Lummi Indian Business Council (LIBC) own more than 75 percent of the upland area; 100 percent of the tideland areas are held in trust by the United States for the Lummi Nation.

4.4. Climate

The Pacific Northwest climate and ecology are largely shaped by the interactions that occur between seasonally varying precipitation patterns and the region's mountain ranges. Approximately 75 percent of the regions precipitation occurs in just half the year (October – April) when the Pacific Northwest is on the receiving end of the Pacific storm track. Based on climate data collected at the nearby Bellingham International Airport, the average annual precipitation on the Reservation is approximately 36 inches. On average, November, December, and January are the wettest months; June, July, and August are the driest months. Because most of the precipitation occurs during the winter months when evapotranspiration demand is low, all of the groundwater recharge and most of the storm water runoff occurs during this season. After the rainy season and during the summer months with low rainfall and high evapotranspiration demand, vegetation slows the movement of storm water, and the amount of water available for groundwater recharge or surface water runoff is small.

Temperature on the Reservation is relatively mild year round. Temperature data collected at the Bellingham Airport from 1949-2005 indicate that the warmest months are July and August. During these months the average maximum daily temperature is approximately 71 degrees Fahrenheit (°F). December and January are the coldest months when the average minimum daily temperatures are about 32°F. The growing season is “the portion of the year when soil temperature (measured 20 inches below the surface) is above biological zero (5°Celsius [C] or 41°F)”. May through September is the approximate growing season for agricultural crops in the area (Gillies 1998).

Wind data for Bellingham indicate that the prevailing wind direction on the Reservation is from the south and southeast with gusts upward of 80 miles per hour. Winds from the west are not as common and generally not as strong (Corps 1997). However, strong winds from the west-northwest, coupled with a high tide, have resulted in damaging coastal flooding along the Sandy Point Peninsula and coastal erosion along the Lummi Peninsula. Wind roses developed from meteorological data collected at two locations on the Reservation as part of a wind energy development feasibility assessment over the January 2011 through January 2012 period indicate that the wind direction is from the south-southeast or south about 50 percent of the time and from the north or northeast about 15 percent of the time (DNV KEMA 2012).

The Reservation experiences a variety of infrequent weather patterns. A typical but infrequent weather pattern is generated from the northeast by cold air masses moving down the Fraser River valley. Strong winds from this pattern, blowing across the Fraser and Nooksack river basins, have caused damage to the residents and businesses of the Reservation (USDA 1992). Another typical but infrequent weather pattern involves continental air masses from the east that bring unusually dry weather that can last a few days or weeks (USDA 1992). During the summer, these air masses bring unusually warm temperatures (mid to upper 90s Fahrenheit). During the winter, these air masses usually bring cold temperatures (0°F and colder).

4.5. Hydrogeology

The hydrogeologic conditions on the Lummi Indian Reservation have been described previously by the USGS and others (Washburn 1957, Cline 1974, Easterbrook 1973, Easterbrook 1976). In



Figure 4.5 Topography, Surface Water Drainages, Place Names, and Roads of the Lummi Reservation

general, the Reservation is underlain by unconsolidated sediments deposited as glacial outwash, glaciomarine drift, glacial till, and floodplain or delta deposits of Quaternary age (Washburn 1957). The unconsolidated deposits consist of clay, silt, sand, gravel, and boulders. Because the composition of the deposits commonly change over short vertical and horizontal distances, it is difficult to distinguish the different stratigraphic units from the existing well log data.

4.5.1. Reservation Aquifers

Groundwater in Reservation aquifers is obtained primarily from outwash deposits of sand and gravel in the unconsolidated glacial sediments, which are recharged by local precipitation. Glaciomarine drift is at or near the ground surface over much of the upland areas on the Reservation. The glaciomarine drift overlays the outwash deposits and contains substantial amounts of clay. This clay restricts the recharge to the underlying aquifer and promotes storm water runoff.

Two (apparently separate) potable groundwater systems occur on the Reservation. One system is located in the northern upland area. This northern system appears to flow onto the Reservation from the north and drains to the west, south, and east. The second potable groundwater system is located in the southern upland area of the Reservation (Lummi Peninsula) and is completely contained within the Reservation boundaries (LWRD 2011b). The floodplain of the Lummi and Nooksack rivers, which contains a surface aquifer that is saline, separates the two potable water systems (Cline 1974). A third potable water system may exist on Portage Island, but information on the water quality and the potential yield of this system is limited and inconclusive (LWRD 2011b).

Because the hydrogeologic conditions on the Reservation vary considerably over short distances, the precise locations of the aquifer recharge zones are not definitively known at this time. It is likely that aquifer recharge areas are distributed over the upland areas. However, given the low infiltration potential of the glaciomarine drift that covers much of the Reservation upland, it is also possible that aquifer recharge areas are of limited areal extent and are located primarily in only a few locations around the Reservation. Until information that is more precise is developed, all of the northern and southern upland areas on the Reservation are assumed to be aquifer recharge zones.

4.5.2. Hydrologic Soil Groups

The United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) has identified and described 39 different soil map units on the Reservation (USDA 1992). As part of the USDA-NRCS characterization, each soil type was assigned to one of four hydrologic soil groups based on their runoff-producing characteristics. The hydrologic soil group, along with the cover type, drainage area, channel length, and land slope, can be used in the USDA Curve Number Method to estimate runoff volumes, peak discharge, and hydrographs for specified storms (USDA 1970). The primary consideration in assigning a soil to a hydrologic soil group is the inherent infiltration capacity of the soil with no vegetation (USDA 1992). The hydrologic soil groups, which are labeled A, B, C, or D, are described in Table 4.3. In essence, Group A soils have a low runoff potential and a high infiltration potential whereas Group D soils have a high runoff potential and a low infiltration potential.

Table 4.3 Descriptions of Hydrologic Soil Groups on the Lummi Reservation

Hydrologic Soil Group	Description ¹	Percent of Reservation Soils
A	Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep (3-6+ ft), well- to excessively drained sands (loamy sands, sandy loam, and sands) and/or gravel. These soils have a high rate of water transmission and a low runoff potential.	2.7
B	Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep (20+ inches) and moderately well- to well-drained soils with moderately fine to moderately coarse textures (loam, silt loam). These soils have a moderate rate of water transmission and a moderately low runoff potential.	10.0
C	Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water and (2) soils with moderately fine to fine texture (sandy clay loam) and a slow infiltration rate. These soils have a slow rate of water transmission and a moderately high runoff potential.	40.4
D	Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential, (2) soils with a high permanent water table, (3) soils with clay pan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission and a high runoff potential.	46.9

¹ USDA 1970

As shown in Table 4.3, about 13 percent of the soils on the Reservation have a low or moderately low runoff potential (Group A or Group B). The remaining 87 percent of the soils on the Reservation have a moderately high or high runoff potential (Group C or Group D). These soil characteristics suggest that less than 15 percent of the Reservation uplands have a good aquifer recharge potential. As shown in Figure 4.6, the Group C and D soils are found in much of the upland areas and in the floodplain of the Lummi and Nooksack rivers. Most of the northern and southern upland areas on the Reservation have a moderately high or high runoff potential. A review of the soil map units in the areas north of the Reservation suggests that most of these soils also have a moderately high or high runoff potential. The low infiltration potential of the soils in the floodplain and Sandy Point areas of the Reservation extends the amount of time that impounded floodwaters and local ponding of water cover the ground.

4.6. Reservation Watersheds

Reservation watersheds were initially delineated and mapped during the development of the 1998 Lummi Reservation Storm Water Management Program (SWMP) Technical Background Document based on available 7.5 minute quadrangle mapping with a 20-foot contour interval and field observations. The watershed boundary map developed as part of the SWMP is a working map that was intended to change as new information is acquired. The initial map was first modified to account for field observations made during the field verification element of the

comprehensive wetland inventory of the Reservation (Harper 1999; LWRD 2000a). During 2010 the watershed delineation map was modified to incorporate the results of a Light Detection and Ranging (LIDAR) data collection effort and the resultant digital elevation models of the Reservation and the areas adjacent to the Reservation (Figure 4.6) (LWRD 2011a).

Alphabetic letters A through S identified the Reservation watersheds that resulted from the initial evaluation. The watershed delineations that resulted from the LIDAR based digital elevation models resulted in the incorporation of two of the initial watersheds (Watershed N and Watershed M) into other watersheds. It is anticipated that names will be assigned to each watershed over time. Seventeen watersheds drain the Reservation uplands into Lummi and Bellingham bays, Hale Passage, and Georgia Strait. The watersheds vary in size from 134 acres up to 4,097 acres not including the Nooksack River watershed. The Nooksack River discharges to Reservation tidelands, but most of the approximately 786 square mile (503,040 acres) Nooksack River watershed is upstream of the Reservation. Seven of the watersheds originate off-Reservation and the remaining ten occur entirely within the Reservation.

4.7. Surface Water Resources

Surface waters on the Reservation include the Nooksack River, the Lummi River, sloughs, small streams, roadside and agricultural ditches, springs, wetlands, estuaries, and marine waters. There are approximately 38 miles of marine shoreline surrounding the Reservation (except along portions of the east boundary and the northern boundary). The associated tidelands extend from the Georgia Strait to Lummi Bay, Hale Passage, Portage Bay, and Bellingham Bay. In addition to marine waters, there are approximately 24.4 miles of rivers, streams, sloughs, and drainages on the Reservation including the multiple distributary channels of the Nooksack River delta (Figure 4.7). There are no lakes on the Reservation, but there are approximately 13 ponds.

4.7.1. Rivers, Sloughs, Streams, and Ditches

The Nooksack River drains most of western Whatcom County and currently flows through the Reservation and discharges into the marine water of Bellingham Bay near the eastern extent of the Reservation. The Nooksack River reach located on the Reservation is tidally influenced. Streamside levees are in place to protect adjacent lands from flooding and agricultural lands from saline water. Several named sloughs, which are remnants of former river channels, have been incorporated into the agricultural drainage network built on the floodplain of the Lummi and Nooksack rivers.

The Lummi River currently carries storm water runoff from the Ferndale upland as well as the drainage from a complex network of agricultural ditches in the floodplain. Tidal waters enter the Lummi River from Lummi Bay twice daily and during the late dry season saline water extends upstream to at least Slater Road. Although Nooksack River water currently flows through a collapsed four-foot diameter culvert into the Lummi River channel only during high-flow events (greater than approximately 9,600 cubic feet per second [cfs]), available data indicate that the Lummi River flow was around 200 cfs as recently as June 1955 (WSDC 1964), when a 5-foot culvert allowed freshwater to flow from the Nooksack River into the Lummi River channel (Deardorff 1992).

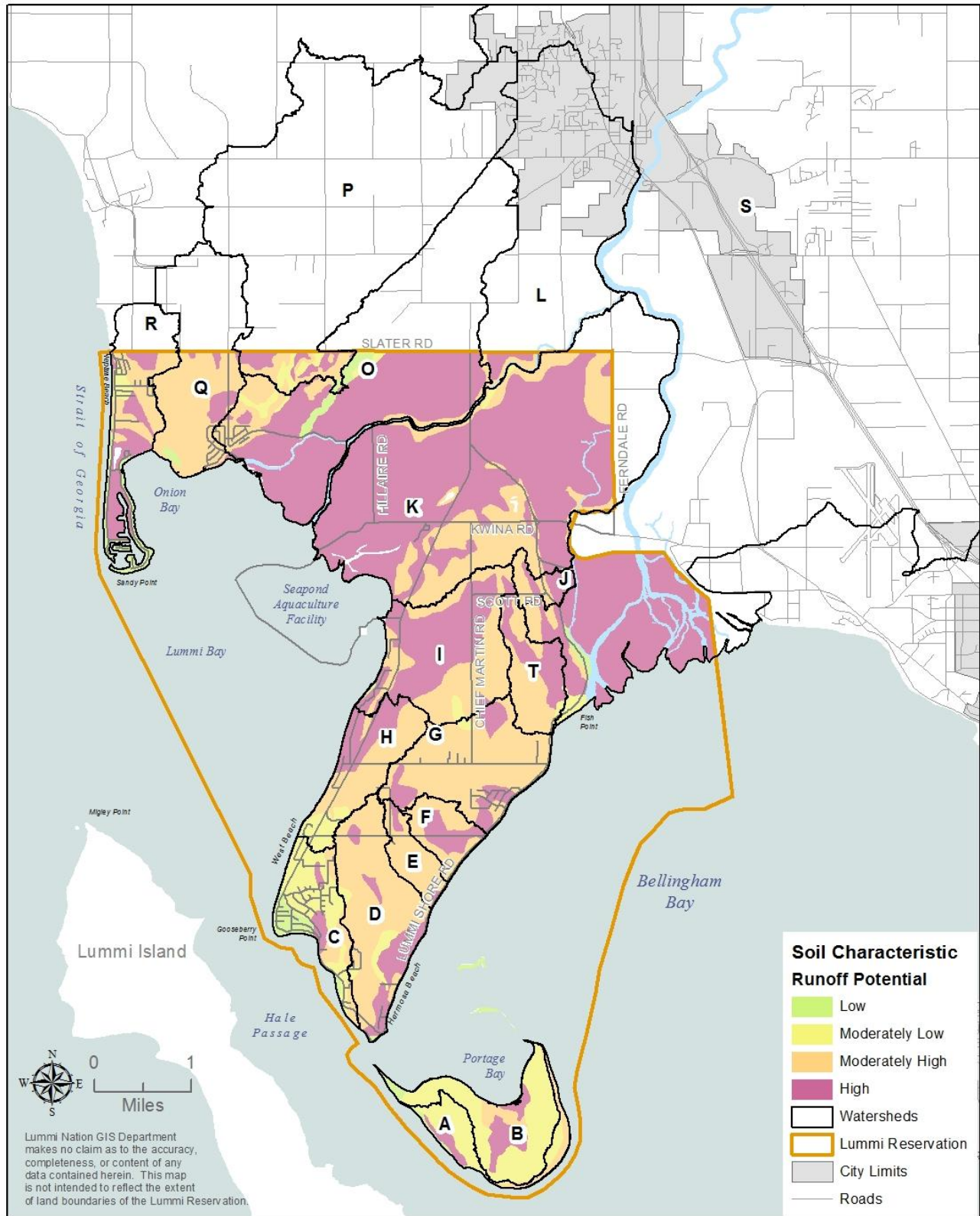


Figure 4.6 Hydrologic Soil Groups, Watersheds, and Surface Waters of the Lummi Reservation

There are several mapped and previously unmapped streams on the Reservation. Most of the unmapped streams have poorly defined channels and contain surface flow only during the October through May period (wet season). The approximate locations of these streams were identified as part of the inventory of storm water facilities. No flow conditions were observed in all of the streams during a field survey of all Reservation streams in late August 1996.

4.7.2. Springs and Wetlands

Upland springs are found throughout the Reservation and are commonly groundwater discharge zones for shallow, perched aquifers. A seep or spring occurs if the land surface intercepts the aquifer, and wetlands may occur at the seep or spring if conditions are favorable (e.g., clayey soils, shallow slope). In addition to upland springs, springs occur along the shoreline or below the ordinary high water line (vegetation line) at numerous locations on the Reservation.

Historically, springs emerging in the uplands served as a water supply for the Lummi people. In many cases, the springs are part of a wetland system in which the water reinfilters along the lower terraces to return to groundwater. The springs are important for wildlife habitat and for aquifer recharge and protection. Upland aquifers, which provide the primary Reservation drinking water supply as well as water for salmon egg incubation and rearing in the hatchery program, have experienced depletion and saltwater intrusion. Where it occurs, the infiltration of freshwater above the shorelines provides a buffer against saltwater intrusion.

The 1999 comprehensive inventory of Reservation wetlands indicated that approximately 43 percent of the Reservation land area is either wetlands or wetland complexes (Harper 1999, LWRD 2000a). Wetland complexes are areas where wetlands and uplands form a highly interspersed mosaic. During the wetland inventory, boundaries were drawn around the outer edges of the mosaic of upland and wetland areas and the entire area was labeled as a “wetland complex”. Consequently, the estimated total wetland area identified in the inventory represents more wetland area than actually exists. Approximately 60 percent of the floodplain on the Reservation was classified as wetlands or wetland complexes (Lynch 2001). An update to the 1999 wetlands inventory is currently underway. The update includes using Global Positioning System (GPS) technology to refine the locations and extent of all wetlands on the Reservation and the collection of additional information on the functions and classifications of these wetlands. As of December 31, 2012 approximately 241 wetlands and 3,217 acres of wetland area have been evaluated as part of the update to the 1999 wetland inventory (LWRD 2013). Figure 4.7 presents the results of the 1999 wetland inventory as currently updated by the ongoing GPS-based wetland inventory.

Most of the once extensive floodplain wetlands of the Lummi and Nooksack rivers have been diked, drained, filled, and cultivated since the late 1800s. Low areas near some of the sloughs still reflect the rich and complex wetland habitat that likely covered most of the lower floodplain before human alteration. Small estuarine wetlands lie in sheltered, low energy areas at Onion Bay, Neptune Beach, Portage Island, the Lummi River floodplain, the Nooksack River delta, and adjacent to the Seaponds Aquaculture Facility dike. Road construction and agricultural activity have altered the wetlands that are north of Marine Drive and adjacent to the Nooksack River. South of Marine Drive, many of the wetlands in the Nooksack River delta have been physically altered by the accumulation of sediment deposited by the Nooksack River as it discharged to the marine waters of Bellingham Bay. The Nooksack River delta was identified as the fastest

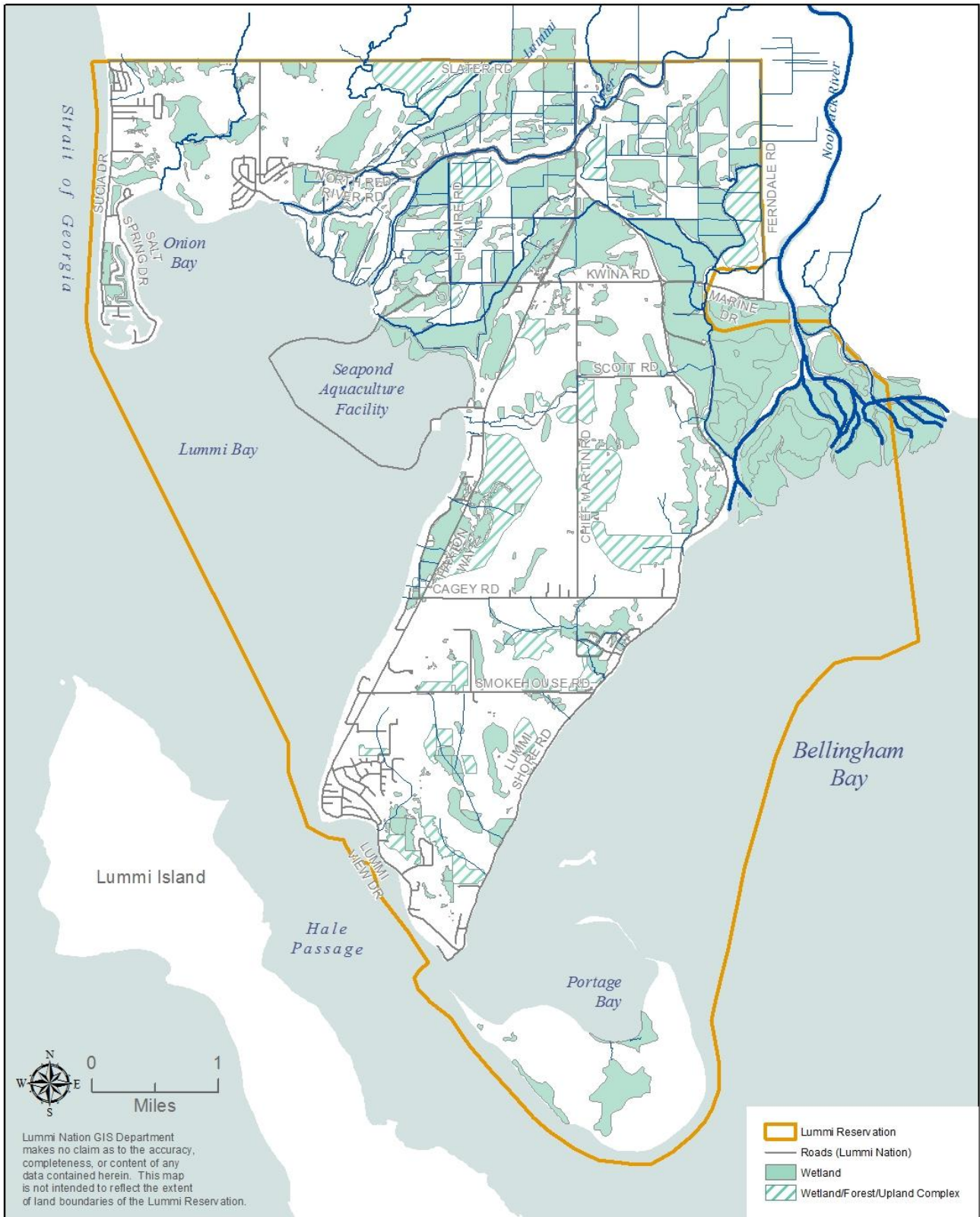


Figure 4.7 Wetlands and Streams on the Lummi Reservation

growing delta relative to its basin size in Puget Sound, with a progradation of approximately one mile over the 1888-1973 period (Bortleson et al. 1980). Consequently, a large area that was once intertidal is now supratidal and new wetlands have been formed. In addition to the delta progradation, the wetlands of the Nooksack River delta are likely affected by the low instream flows and poor water quality that characterizes the river during some summer months.

The majority of the estuarine wetlands of the Lummi and Nooksack rivers will be protected and functionally improved in the future through the implementation of the Lummi Nation Wetland and Habitat Mitigation Bank. The mitigation bank will be developed in phases. Phase 1A, which encompasses most of the Nooksack River estuary, became operational during 2012. The area will be protected into perpetuity through a conservation easement and enhancement measures like invasive species control and under planting with conifers will improve the ecological functions of the estuary. The mitigation bank will be used to mitigate unavoidable impacts to habitat and wetlands on the Reservation, but credits will also be available to buyers in the service area surrounding the Reservation.

Remnants of what were once extensive high-value wetlands are located on the Sandy Point Peninsula between Sucia Drive and the private Sandy Point marina. The private Sandy Point marina and its associated canal system were excavated in the 1960s from uplands that were periodically inundated by marine waters. Road construction, dense residential development and associated shore defense works, and drainage facilities now limit tidal inundation, but wildlife and wetland vegetation is abundant. Plants of traditional cultural significance have been identified in this area. Further north along Sucia Drive, formerly dry and seasonally wet areas are now permanently flooded as a result of road construction that blocked natural drainage.

These palustrine/estuarine emergent wetlands of the lowlands/floodplains are significant for storm water attenuation, floodwater storage, water quality enhancement, fish habitat, wildlife habitat, and for plants with traditional cultural importance. The estuarine wetlands provide critical rearing habitat for migrating salmon, herring, smelt, and other finfish and shellfish. The significance of these wetlands is increasing as wetlands upstream from the Reservation are altered and destroyed. These Reservation wetlands reduce the water quality impacts of land uses on Lummi commercial, ceremonial, and subsistence shellfish beds in Portage and Lummi bays. Protecting and enhancing floodplain and estuarine wetlands is essential to preserving and/or restoring interdependent fish, shellfish, and wildlife habitats in addition to reducing flood damage.

4.7.3. Estuarine and Marine Waters

Brackish estuarine waters grade to marine waters of the Reservation in Lummi Bay, Portage Bay, portions of Bellingham Bay and Hale Passage, and the shoreline along Georgia Strait. Saline water moves across tideflats and into the Lummi and Nooksack river channels twice daily with the tidal cycle. The saltwater underlies the less dense freshwater and moves as a wedge upstream. Saltwater has been observed upstream as far as Slater Road in the Lummi River but has not been observed along Marine Drive in the Nooksack River. Tidal effects on the water level (backwater effects) in the Nooksack and Lummi rivers have been observed even further upstream and possibly occur as far upstream as Ferndale during certain flow and tidal conditions.

Estuarine waters of the Nooksack and Lummi river deltas form the interface between marine and freshwater. Estuarine waters are important habitat for juvenile and adult salmon as they acclimate to either saline or freshwaters during their seaward and landward/spawning grounds migrations, respectively. Estuaries also serve as habitat for juvenile and adult individuals of many other important aquatic species (LNR 2010).

The complex and rich aquatic resources that provide feeding grounds for fish also attract a large variety of wildlife. The estuaries of the Lummi and Nooksack rivers are a part of the Pacific Coast flyway for ducks, geese, swans, and shorebirds. These estuaries are also habitat for peregrine falcon and bald eagle; both formerly listed species under the Endangered Species Act (ESA). Estuarine wetland ecosystems in general, including saltwater marshes, are considered among the most productive (in biomass production per unit area) natural ecosystems on earth. In addition to providing rearing habitat for juvenile salmonids and other species, these ecosystems export a large amount of biomass to estuaries. This biomass can form a large portion, sometimes the majority, of the base of the estuarine food web (Mitsch and Gosselink 1993).

Lummi Bay tideflats are extensive and rich in resources for tribal commercial, subsistence, and ceremonial purposes and as feeding areas for wildlife. Less extensive tideflats at Gooseberry Point, the Stommish Grounds, and Portage Bay are also important to the tribal economy and culture. The Lummi Intertidal Baseline Inventory (LIBI) was completed in 2010 in order to document the existing diversity, abundance, distribution, and habitats of the biological resources that are found on the Reservation tidelands. The LIBI integrates the results from six surveys that were conducted in 2008 and 2009 with compatible pre-existing information. Over 242 separate taxa were documented on the Reservation during the LIBI (LNR 2010).

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5. NATURAL HAZARD RISK ASSESSMENT

Fundamental to effective hazard mitigation is information related to the nature, distribution, probability of occurrence, frequency, intensity, and severity of historical hazard events. When linked to demographic, socioeconomic, built systems, and other societal information, risk evaluations and vulnerability assessments can be performed. This plan focuses on natural hazards (i.e., flooding, earthquakes, severe winter storms, windstorms, coastal erosion, drought, wildfires, landslides, tsunamis, volcanic eruptions, and tornadoes). The potential impacts of climate change to the natural hazards that currently exist on the Reservation are discussed briefly where relevant; more detailed information and evaluation of vulnerabilities can be found in the Assessment of Climate Change Impacts on the Lummi Indian Nation (LWRD 2015). Similarly, human-caused hazards associated with toxic emissions and/or hazardous material spills are addressed in the 2005 Lummi Nation Spill Prevention and Response Plan (LWRD 2005).

The following assessment of natural hazard risks on the Reservation describes the nature and location of past and potential future natural hazard events; describes the vulnerability of Reservation's assessment areas to each hazard; estimates the value of structures and/or property in areas that are vulnerable to hazards; describes critical infrastructure and vulnerable populations; and provides an analysis of the risk to life, property, economic activity, and the environment that may result from natural hazard events on the Reservation. After a brief description of the methods used to conduct this risk assessment, the remainder of this section addresses each of the identified natural hazards that may affect the Reservation.

5.1. Assessment Areas

Prior to the 2010 update, the Lummi Nation Multi-Hazard Mitigation Plan (MHMP) met the requirements of a state-level plan, wherein hazards, vulnerabilities, and risks were to be assessed separately by local jurisdictions. Because the LIBC is the sole governing body of the Lummi Nation, division amongst local jurisdictions was irrelevant and the assessment was instead divided into six geographic areas. After the plan changed from a state-level plan to a tribal-level plan in 2010, the continued use of the geographic assessment areas was recommended because the assessment areas were found to simplify the evaluation and interpretation of relative risks to different areas on the Reservation. The six assessment areas are the Sandy Point Peninsula, the Northwest Upland, the Floodplain (Nooksack and Lummi river floodplains, including the Seaponds dike and Lummi Bay salmon and shellfish hatcheries), the Lummi Peninsula, Gooseberry Point (i.e., coastal flooding area at the southwest corner of the Lummi Peninsula), and Portage Island. The Portage Island assessment area is currently unoccupied and undeveloped. As a result, the Portage Island area was assessed for hazard vulnerability, but not for potential losses. Figure 5.1 identifies these six areas of the Reservation.

Within each assessment area, estimates of population and structure values are provided. As discussed previously, the 2010 US Census reported that 4,706 persons lived on the Reservation in 2010. This information, along with the Lummi Natural Resources Department's (LNR) Geographic Information System (GIS) 2014 parcel and address data, was used to estimate the number of residents within each assessment area. Because land ownership on the Reservation is divided into five categories (i.e., tribal trust, tribal fee, individual native trust, individual native

fee, and fee), several different data sources were needed to derive estimates of structure values. Structure values for tribal trust and tribal fee properties are reported as the insured value of real property (i.e., structures) and personal property (i.e., contents) for all tribal institutions (LIBC, NWIC, LCC, LHA, and Silver Reef Hotel, Casino & Spa) with the exception the Lummi Tribal Sewer and Water District (LTSWD). The structure values reported for the LTSWD are estimated replacement costs based on the actual cost of construction for recent projects or estimated construction costs for planned projects. Replacement costs were used in this analysis rather than insured values because they were found to more accurately reflect potential losses from damages to LTSWD infrastructure in the event of a natural disaster. Structure values for individual native fee and fee properties were obtained from the 2014 Whatcom County Assessor's database. Assessed values are not available for individual native trust properties. As a result, the structure values for individual native trust properties were estimated using the average value of residential fee properties within a given assessment area.

5.1.1. Lummi Peninsula Assessment Area

The Lummi Peninsula is the largest assessment area, covering 5,790 acres, and with a maximum elevation of 178 feet NAVD88. This area has approximately 17 miles of marine shoreline and several stretches of steep beach slopes along Lummi Shore Road, Lummi View Drive, and West Beach. The Lummi Peninsula also has the largest extent of forested land on the Reservation. The Lummi Peninsula assessment area had approximately 1,170 residences in 2014 and accounted for approximately 52 percent of the Reservation population. There were 115 licensed businesses in this area in 2014, most of which were operated out of homes rather than storefronts. Also located within this assessment area are a wide variety of public services. Along the Kwina Road corridor, services include the new LIBC Tribal Administration Center (became operational in 2013), the LIBC east, central, and west campuses, the Tribal Health Clinic, the Lummi Early Learning Programs (including Head Start), and the Northwest Indian College. In the southern portions of the peninsula, public services include the Lummi Nation School (K-12), the Lummi Youth Academy, the Little Bear Creek Elders Home, the Wex'li'em (Community Building and Red Cross shelter), the Stommish Grounds, and others. The Lummi Tribal Sewer and Water District (LTSWD) operate several facilities across the Lummi Peninsula assessment area, including the Gooseberry Point and Kwina Road wastewater treatment plans, pump stations, wells, and water reservoirs. Emergency services located in this assessment area include the Lummi Police Department (located at the Tribal Administration Center) and the Gooseberry Point Fire Station (Whatcom County Fire District No. 8). Table 5.1 provides the number and value of structures in this assessment area.

5.1.2. Floodplain Assessment Area

The Floodplain assessment area encompasses the Lummi River and the Nooksack River floodplains and is the second largest assessment area, covering 4,863 acres, and with an average elevation of 8 feet NAVD88. The floodplains are largely agricultural lands or wetlands. Nearly 2,000 acres of the floodplain are designated for use in the Lummi Nation Wetland and Habitat Mitigation Bank. The Floodplain assessment area had approximately 50 residences in 2014 and accounted for approximately 2 percent of the Reservation population. There were 13 licensed businesses in this area in 2014. The primary commercial enterprises are the Silver Reef Hotel, Casino & Spa and adjacent Lummi Mini-Mart and gas station located near the intersection of Slater Road and Haxton Way. The Silver Reef Hotel, Casino & Spa has an average of over

3,000 visitors per day and employs nearly 600 staff. There are also typically over 50 licensed fireworks stands that are operated seasonally, most of these stands are nonpermanent. Also of importance within this assessment area and located at the Lummi Seaponds Aquaculture Facility are the Lummi Bay Salmon Hatchery and the Shellfish Hatchery. These hatcheries support the Lummi Nation's commercial, ceremonial, and subsistence fisheries. Table 5.1 provides the number and value of structures in this assessment area.

5.1.3. Northwest Upland Assessment Area

The Northwest Upland assessment area covers 1,404 acres and has a maximum elevation of 216 feet NAVD88. The Northwest Upland is largely forested, with the exception of the dense residential development in the area called Sandy Point Heights. Most of the 414 residences in the Northwest Upland are located within this development. Approximately 18 percent of the Reservation population lives in this area. There were nine licensed businesses in this area in 2014. Public services in this assessment area include a fire station (Whatcom Fire District No. 17) and Lummi Tribal Sewer and Water District infrastructure. Table 5.1 provides the number and value of structures in this assessment area.

5.1.4. Portage Island Assessment Area

Portage Island lies at the southeastern tip of the Lummi Peninsula assessment area. A sand and gravel bar (tombolo) connects the island to the Peninsula at low tide, allowing light vehicles (e.g., cars, trucks, motorcycles) overland access to the island. Portage Island is 932 acres, has a maximum elevation of 209 feet NAVD88, and is largely forested. The island is currently uninhabited.

5.1.5. Sandy Point Peninsula Assessment Area

The Sandy Point Peninsula assessment area covers 418 acres and has an average elevation of 11 feet NAVD88. The peninsula is a depositional landform exposed to the Strait of Georgia on the western side and Lummi Bay on the eastern side. An artificial canal forms a marina that extends from the southern tip of the peninsula to nearly one mile north. There were 486 residences on the Sandy Point Peninsula in 2014. Although it comprises a relatively small area of the Reservation, approximately 22 of Reservation population are located within this assessment area. There were three licensed businesses in this area in 2014. Public services in the Sandy Point Peninsula assessment area include the Sandy Point Fire Station (Whatcom Fire District No. 17), the LTSWD Sandy Point Wastewater Treatment Plant, and the Sandy Point Salmon Hatchery. Table 5.1 provides the number and value of structures in this assessment area.

5.1.6. Gooseberry Point Assessment Area

The Gooseberry Point assessment area is located at the southwestern tip of the Lummi Peninsula. This is the smallest of the Reservation's assessment areas, covering only 58 acres, and has an average elevation of 11 feet NAVD88. This area was separated from the adjacent Lummi Peninsula assessment area for the purposes of mitigation planning because Gooseberry Point is subject to coastal flooding. The Gooseberry Point assessment area had approximately 120 residences in 2014 and accounted for 5 percent of the Reservation population. There were four licensed businesses in this area in 2014. Public services at Gooseberry Point include the Fishermen's Cove Pier and associated repair shop and boat storage facilities, the Fishermen's

Cove Mini-Mart, and the Whatcom County Ferry Terminal serving Lummi Island. Table 5.1 provides the number and value of structures in this assessment area.



Figure 5.1 Hazard Assessment Areas on the Lummi Reservation

Table 5.1 Number and Value of Structures in the Six Assessment Areas

Area	Structure Type	Number of Structures	Estimated Value ¹		Comments
			Structure(s)	Contents ²	
Lummi Peninsula	Tribal Administration Center	2	\$34,636,895	\$1,488,552	<ul style="list-style-type: none"> ▪ Critical Facility: Public safety (Police Department) ▪ Includes Tribal Administration Building and Maintenance Building
	LIBC West Campus	5	\$2,634,300	\$529,707	<ul style="list-style-type: none"> ▪ Critical facility: Food source (Commodity Foods) ▪ Includes Community Services, Children's Services, JOM, Lummi Housing Authority, Bus Barn
	LIBC Central Campus	4	\$2,859,111	\$459,466	<ul style="list-style-type: none"> ▪ Includes Archives, CARE, Journey to Wellness, LNR Shop
	LIBC East Campus	3	\$2,084,469	\$154,269	<ul style="list-style-type: none"> ▪ Includes Youth Recreation and Wellness Center
	Tribal Health Clinic	3	\$5,448,533	\$2,363,583	<ul style="list-style-type: none"> ▪ Critical Facility: Public health ▪ Includes Health Clinic and Fitness Center
	Lummi Early Learning Programs	4	\$8,249,599	\$228,123	<ul style="list-style-type: none"> ▪ Vulnerable Population: ~200 infant to preschool aged children ▪ Includes Head Start and Early Head Start
	Lummi Childcare (formerly)	2	\$973,947	\$44,671	<ul style="list-style-type: none"> ▪ Childcare moved to the new Head Start facility – this space is currently leased
	Northwest Indian College	23	\$25,992,719	\$2,552,296	<ul style="list-style-type: none"> ▪ Approximately 600 full- and part-time students
	Lummi Nation School	1	\$38,906,719	\$1,194,392	<ul style="list-style-type: none"> ▪ Vulnerable Population: ~400 K-12 students
	Lummi Youth Academy	1	\$2,197,178	\$179,240	<ul style="list-style-type: none"> ▪ Vulnerable Population: ~25 student residents
	Teen Parent Child Development Center	1	\$374,778	\$187,389	<ul style="list-style-type: none"> ▪ Vulnerable Population: ~12 infant to toddler aged children
	Family Services	3	\$529,426	\$50,692	<ul style="list-style-type: none"> ▪ Includes Victims of Crime Shelter and Safehouse
	Wex'li'em (Community Building)	1	\$3,283,988	\$227,293	<ul style="list-style-type: none"> ▪ Critical Facility: Red Cross Shelter
	Little Bear Creek Elders Home	2	\$4,175,849	\$2,087,925	<ul style="list-style-type: none"> ▪ Vulnerable Population: ~30 resident elders
	Stommish Grounds	4	\$695,299	\$50,505	<ul style="list-style-type: none"> ▪ Includes Veterans Center, Canoe Storage, Stage Hall
	LCC Office	1	\$750,000 ³	\$150,000 ³	
	Gooseberry Point Fire Station	1	\$490,019 ⁴	\$818,213 ⁴	<ul style="list-style-type: none"> ▪ Critical Facility: Public safety

Table 5.1 Number and Value of Structures in the Six Assessment Areas

Area	Structure Type	Number of Structures	Estimated Value ¹		Comments
			Structure(s)	Contents ²	
	Lummi Tribal Sewer and Water District Facilities	40	\$25,500,000 ⁵	-	<ul style="list-style-type: none"> ▪ Critical facility: Water supply, wastewater treatment ▪ Includes Gooseberry Point WWTP, Kwina Road WWTP, wastewater pump stations (19), wells (12), and reservoirs (3) and associated infrastructure
	Residences	1,170	\$128,254,969	\$64,127,484	
	Area Total	1,271	\$288,037,798	\$76,893,800	
Floodplain	Silver Reef Hotel, Casino, & Spa	1	\$61,117,907 ⁶	\$36,023,333 ⁶	<ul style="list-style-type: none"> ▪ Critical facility: Food source, potential use as shelter
	Lummi Mini-Mart	1	\$1,129,000 ³	\$400,000 ³	<ul style="list-style-type: none"> ▪ Critical facility: Food source, gas source
	Shellfish Hatchery	2	\$2,478,336	\$413,212	
	Lummi Bay Salmon Hatchery	4	\$1,231,122	\$164,597	
	Lummi Tribal Sewer and Water District Facilities	3	\$1,200,000 ⁵	-	<ul style="list-style-type: none"> ▪ Critical Facility: Wastewater treatment ▪ Includes wastewater pump stations (3) and associated infrastructure
	Residences	50	\$4,628,564	\$2,314,282	
	Area Total	61	\$71,784,929	\$39,315,424	
Northwest Upland	Sandy Point Heights Fire Station	1	\$70,000 ⁴	\$225,000 ⁴	<ul style="list-style-type: none"> ▪ Critical Facility: Public safety
	Lummi Tribal Sewer and Water District Facilities	8	\$3,075,000 ⁵	-	<ul style="list-style-type: none"> ▪ Critical Facility: Water supply, wastewater treatment ▪ Includes wastewater pump station (1), water reservoirs (2), arsenic treatment facility (1), booster station (1), and wells (3) and associated infrastructure
	Residences	414	\$27,763,605	\$13,881,802	
	Area Total	423	\$30,908,605	\$14,106,802	
Portage Island	None	n/a	n/a	n/a	<ul style="list-style-type: none"> ▪ Currently undeveloped and unoccupied

Table 5.1 Number and Value of Structures in the Six Assessment Areas

Area	Structure Type	Number of Structures	Estimated Value ¹		Comments
			Structure(s)	Contents ²	
Sandy Point Peninsula	Sandy Point Fire Station	2	\$400,000 ⁴	\$600,000 ⁴	▪ Critical Facility: Public safety
	Sandy Point Salmon Hatchery	2	\$415,073	\$76,510	
	Lummi Tribal Water and Sewer District Facilities	10	\$8,400,000 ⁵	-	▪ Critical facility: Wastewater treatment ▪ Includes Sandy Point WWTP and pump stations (6) and associated infrastructure
	Residences	486	\$67,439,033	\$33,719,516	
	Area Total	500	\$76,654,106	\$34,396,026	
Gooseberry Point	LIBC Fish Buying Station and Pier	2	\$3,303,960	\$50,170	▪ Critical facility: Lummi Peninsula access in event of riverine flooding ▪ Currently operated by KMB Seafoods
	LCC Dock, Dock Office, Repair Shop, Boat Storage	5	\$1,424,000 ³	\$6,400 ³	▪ Critical facility: Lummi Peninsula access in event of riverine flooding
	Fisherman's Cove Mini-Mart	1	75,000 ³	50,000 ³	▪ Critical facility: Food source, gas source
	Commodity Foods Warehouse (formerly)	1	\$355,218	\$42,173	▪ Commodity Foods moved to the LIBC West Campus – this space is currently leased
	Whatcom County Ferry Terminal	1	\$10,000,000 ⁷	-	▪ Critical facility: Lummi Peninsula access in event of riverine flooding
	Lummi Tribal Sewer and Water District Facilities	1	\$400,000 ⁵	-	▪ Critical facility: Wastewater treatment ▪ Includes pump station (1) and associated infrastructure
	Residences	120	\$7,904,485	\$3,952,243	
	Area Total	131	\$23,462,663	\$4,100,986	

¹Unless otherwise noted, estimated values are 2014 insured values of structures and contents provided by the Lummi Indian Business Council (LIBC)

²For residences and other structures, the estimated contents value equals half of the 2014 structure value or the 2014 insured contents value

³2014 insured values reported by Lummi Commercial Company (LCC)

⁴2014 insured values reported by Whatcom County Fire Districts

⁵2014 replacement costs reported by the Lummi Tribal Sewer and Water District (LTSWD)

⁶2015 insured values reported by Silver Reef Hotel, Casino & Spa

⁷2014 replacement costs reported by Whatcom County Public Works

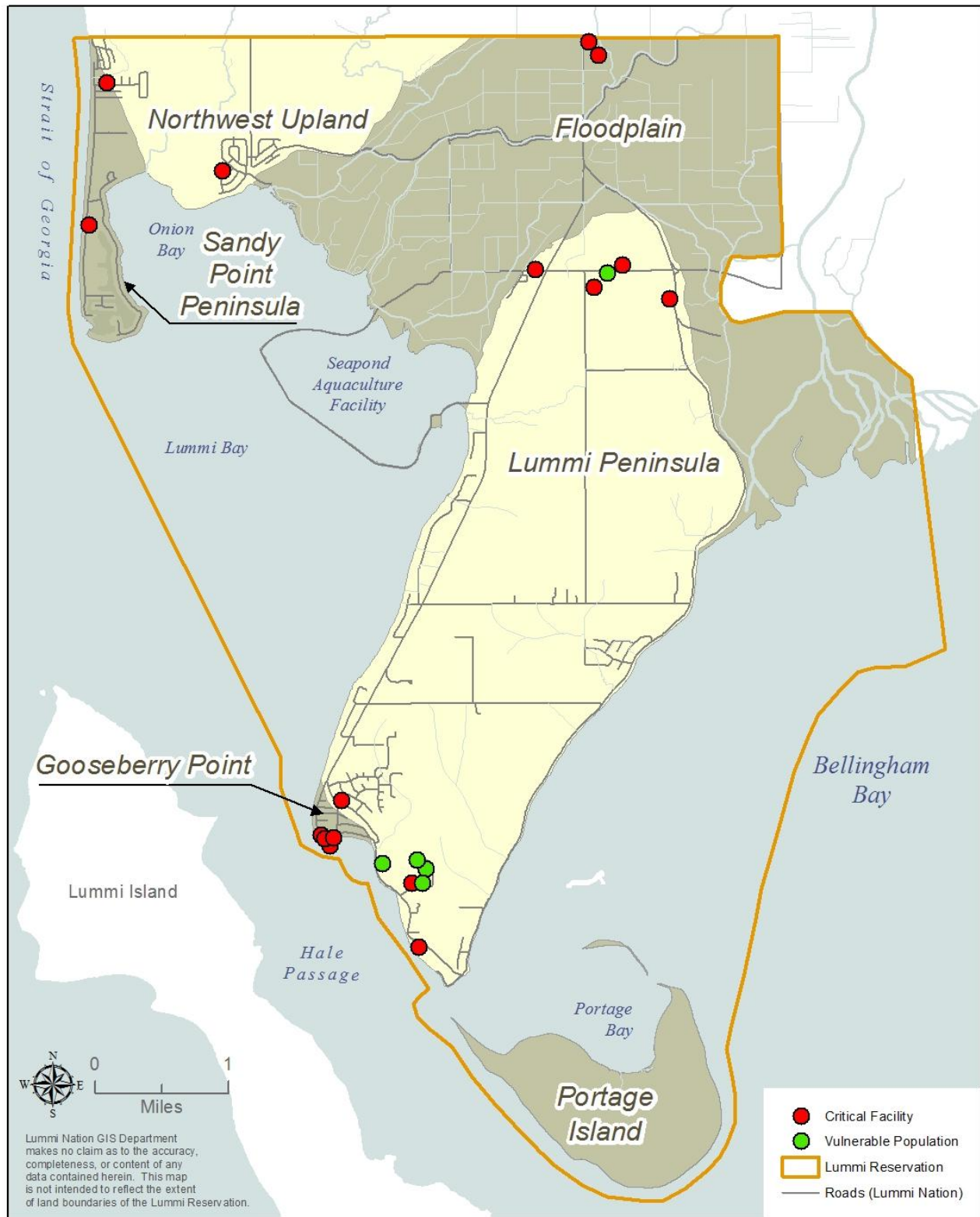


Figure 5.2 Critical Facilities and Vulnerable Populations on the Lummi Reservation

5.2. Cultural Resources

The guidelines for tribal-level multi-hazard mitigation plans require accounting for culturally significant sites in the assessment of the vulnerability to hazards. Culturally significant sites for the Lummi Nation are administered and protected by the Cultural Resources Department in accordance with the Cultural Resources Preservation Code (Lummi Nation Code of Laws [LCL] Title 40). Pursuant to LCL Title 40, cultural resources are defined as follows:

Cultural Resources in the traditional view of Lummi includes, but is not limited to, four major category types: language, including traditional named places and Oral History or Tradition; traditional cultural properties; historic sites; and archeological resources. ‘Cultural Resources’ also means any material remains of past, present, or future human life or activities which are of historic significance, and/or cultural or archeological interest. Such material includes, but is not to be limited to: pottery, basketry, weapons, weapon projectiles; tools, structures or portions of structures, pit houses, rock paintings, rock carvings, intaglios, talus slide depressions, cairns, sea caves, inland caves, graves, human skeletal remains, or any portion or piece thereof, whether or not found in a cultural resource context.

The locations of the recorded historical cultural sites on the Reservation are confidential. Confidentiality is partly due to traditional Lummi values towards sacred and otherwise meaningful sites, and partly to prevent looting or other disturbance. The Cultural Resources Department has identified several cultural resource zones on the Reservation where there is a high likelihood of encountering cultural artifacts. Cultural resource zones are present in each of the six assessment areas. It should be recognized that cultural resources are irreplaceable and the integrity of cultural resources is extremely delicate. When cultural resources are damaged or destroyed, they cannot be renewed, replanted, relocated, or replicated; when they are gone, they are gone forever. The loss of cultural resources could irretrievably harm the wellbeing of the Lummi Nation; these losses cannot be assigned a monetary value.

5.3. Hazard Identification and Vulnerability Assessment

As discussed in Section 2.3 – Existing Documents Review, the Lummi Natural Resources Department took the following steps to identify hazards that have affected the Reservation in the past and/or can be reasonably expected to affect the Reservation in the future:

- Reviewed past state and federal disaster designations;
- Reviewed regional hazard information and analyses prepared by federal, tribal, state, local, and international agencies;
- Reviewed peer-reviewed literature and other academic reports;
- Reviewed websites containing regional hazard information; and
- Reviewed accounts of past hazards that occurred on the Reservation.

The natural hazards that were identified as having affected the Reservation in the past and/or can be reasonably expected to affect the Reservation in the future are floods, earthquakes, severe winter storms, windstorms, coastal erosion, drought, wildfires, landslides, tsunamis, volcanic

eruptions, and tornados. Information acquired from the materials listed above was used to estimate the vulnerability of each Reservation assessment area to each hazard. Vulnerability estimates were based on the following factors:

- Types of damage associated with the hazard;
- Probability of occurrence;
- Frequency of occurrence;
- Probability of damage resulting from a large hazard event;
- Historical and/or potential severity of damage; and
- Comparisons of vulnerability across the Reservation and with other regions.

The relative probability of hazard occurrence (between hazards) is not reflected in the vulnerability assessments. For example, although the Floodplain assessment area was rated as having a high vulnerability to both floods and volcanoes, this area is much more likely to be affected by floods. The ratings for each hazard therefore reflect the estimated vulnerability if a large hazard event occurs. In addition, the amount of development in each assessment area was not factored into the estimated vulnerability for that area. For example, although the Sandy Point Peninsula area and Floodplain area have very different levels of development, they have the same estimated earthquake vulnerability. Instead, different levels of development are reflected in the estimated potential losses for each area. That is, highly developed areas have greater potential losses.

The loss estimates were determined by collecting the number and value of structures within each assessment area. For the 2015 update, the number of structures for each assessment area was determined by GIS analysis of a layer of all structures digitized from 2014 Pictometry® imagery. As described in Section 5.1 – Assessment Areas, structure values were derived from several sources including: (1) insurance reports issued in 2014 for Lummi Indian Business Council (LIBC), Lummi Commercial Company (LCC), Northwest Indian College (NWIC), and the Silver Reef Hotel, Casino & Spa facilities, (2) estimated 2015 replacement costs for Lummi Tribal Sewer and Water District (LTSWD) facilities, (3) building assessed values from the 2014 Whatcom County Assessor’s database for residential fee properties, or (4) estimated 2014 values for residential trust properties based on the average value of surrounding residential fee properties. For each hazard, loss estimation was made for structures and contents for each vulnerability area rating within each of the six assessment areas.

To identify any new hazards and maintain records on previously identified hazards, information on hazards that occurred during the period between 2010 and 2015 was collected. During the first update period (2004-2007), one previously unidentified hazard, a tornado, occurred in Whatcom County and a tornado section was added to the hazard inventory and vulnerability assessment. During the second update period (2007-2010), climate change was identified as an additional hazard and a brief section on climate change was added. The climate change section was developed more fully over the 2010-2015 update period. The section for each existing hazard was updated by including any new or improved information in the description of the hazard, adding events that occurred between 2010 and 2015 to the hazard profile, considering

these new events together with completed mitigation projects in the vulnerability assessment, and including updated insurance and assessed values in the estimation of potential losses.

5.4. Floods

Flooding in riverine systems is a natural occurrence that results when runoff from rain or snowmelt exceeds the carrying capacity of river channels, ditches, drains, reservoirs, and other water bodies. Flooding in coastal areas is a natural occurrence that results when high tides and/or storm-driven waves overtop naturally created storm berms or man-made shore defense works. In this section, past riverine and coastal flood events, flood vulnerability, and potential flood losses on the Reservation are described.

5.4.1. Profiles of Flood Hazards

Flood events on the Lummi Indian Reservation can be divided into two broad categories, (1) flooding of the Nooksack River and (2) coastal flooding along the approximately 38 miles of marine shoreline; each are described in this section. It should be noted that terms such as “100-year flood” are commonly misinterpreted to mean a flood magnitude that only occurs one time during a 100-year period. The term is actually an expression of the probability of occurrence in any given year. As such, the “100-year flood” is the magnitude of a flood event that has a 1 percent probability of occurrence during any one year. Similarly, a “50-year flood” has a 2 percent probability of occurrence during any year and a “5-year flood” has a 20 percent probability of occurrence during any year.

5.4.1.1. Nooksack River Floods

As described previously, the Nooksack River drains a watershed of approximately 786 square miles. Most major floods recorded on the Nooksack River occurred from late October through February. The position of the watershed on the west slopes of the Cascade Mountains results in large amounts of rainfall during warm, wet winter storms. The combination of a heavy storm, a melting low elevation snowpack, and soils already saturated by preceding rainfall results in the most severe floods of the Nooksack River. Since over 70 percent of the watershed is in the mountainous areas above the City of Deming where precipitation is relatively high, the upper basin areas of the watershed contribute most to flood volumes (Whatcom County 1995a).

Large floods of the Nooksack River have occurred throughout history, even before development in the floodplain and land use changes in the upper watersheds. The fact that floods will cause more damage today than several decades ago is more a result of the increasing amount of development susceptible to flooding than a result of increased flood magnitude. However, increased surface runoff and isolation of the river from floodplain storage areas due to environmental alterations by humans (e.g., levees) have combined to increase downstream flows and hence the magnitude of floods.

The largest recorded floods of the Nooksack River are listed in Table 5.2, which also lists the current estimates of the 10-, 50-, and 100-year flood flows for the Nooksack River at Ferndale, Washington. The United States Geological Survey (USGS) stream gage records began in 1935 at Deming and in 1945 at Ferndale. Flows at Ferndale for floods before 1945 are estimated. The information and methods used to develop these estimates are described elsewhere (Whatcom

County 1995a and references therein). Other major known floods before 1935 occurred in 1883, 1891, 1893 or 1894, 1901, and 1927. Data from the adjacent Skagit River basin also indicate extreme floods in western Washington in 1815, 1856, and 1909 (Whatcom County 1995a). According to the information compiled in Table 5.2, two 50-year, two 40-year, six 10-year, and ten 5-year floods have occurred on the Nooksack River since 1945. These higher than predicted recurrence intervals could be due to uncertainty in flood magnitude measurements or estimates (particularly at the Deming gage), an insufficient flood history for accurate recurrence interval calculations, and/or an increase in flood magnitudes in recent decades.

The floodplain infrastructure on the Reservation was originally intended to protect agricultural lands against frequent, low magnitude floods. In 1988, the U.S. Army Corps of Engineers inventoried the lower Nooksack River levee system and determined that the levees of Diking District No. 1 (south of Ferndale) along the west bank of the Nooksack River provided from less than 5-year to up to 10-year flood protection (Figure 5.3) (Corps 1988, NHC 1988). Since that time, and in particular following large flood events in the 1990s, significant levee improvements along the west bank of this reach have been made. Whatcom County is developing an unsteady flow model of the lower Nooksack River that can be used to evaluate the existing levee system (Cooper 2001, 2004). Preliminary model data provided by Whatcom County indicate the majority of levees along the west bank of this reach now provide greater than 100-year protection; however, there are still segments of this reach with lower levels of protection, ranging from less than 5-year protection up to less than 100-year protection (Figure 5.4). Additional flood control structures on the Reservation include levees along the banks of the Lummi River (less than 5-year protection), bank protection made of rip-rap, seawalls along Lummi Bay (less than 5-year protection), tide gates in the Lummi Bay seawall, and floodgates along Lummi Bay and floodplain sloughs.

When the levee along the western side of the lower Nooksack River fails or is overtopped, floodwaters discharge to both Lummi and Bellingham bays. Floodwater moving toward Lummi Bay accumulates landward of the seawall. The tide gates in the seawall are designed to prevent tidal/marine waters from flowing inland but allow the floodwater to drain to Lummi Bay when the tidal elevation is lower than the elevation of the floodwaters. Historically, the tide gates have been overwhelmed and ineffective during large floods. The seawall has been intentionally breached during past floods (i.e., during the 1990 and 1975 floods the dike was intentionally breached at a point between the Lummi River outlet and the north end of the Seaponds Aquaculture Dike) to allow the floodwaters to drain during lower tides. This draining is largely stopped during higher tides as the marine waters flow inland and “back-up” the floodwaters.

The breaches of the seawall allowed saltwater at high tide to reach Haxton Way and the farmlands inland of the seawall. After the 1975 flood, the U.S. Army Corps of Engineers rebuilt a short section of the seawall so that it would wash out under severe flooding. This fuse plug it intended to prevent damage to the rest of the seawall by letting waters pass through only at that designated spot. Fuse plugs are designed to be replaced easily once the flood is over. How well this fuse plug will prevent seawall damage is not yet known (Whatcom County 1997a). If a flood results in a breach of the seawall section next to the Seaponds Aquaculture Dike, extensive damage to this facility can be expected. In addition, in 1998 the six non-functioning tide gates mounted on 36-inch corrugated steel culverts were replaced by five concrete box culverts, four-

feet-wide by six-feet-tall, fitted with “flapper” gates made out of aluminum. Three five-foot by five-foot box culverts drain the northern distributary channel of the Lummi River.

It should be noted that frequency and magnitude of riverine floods are expected to increase in the future as a result of climate change. See Section 5.15 – Hazard Risk Assessment and Climate Change for more information.

5.4.1.2. Sequence of Nooksack River Flooding

One of the first areas to experience flooding on the Reservation as the Nooksack River rises is Marine Drive west of the bridge crossing the river and just upstream from the delta. North of Marine Drive, the west bank levee follows Kwina Slough away from the main Nooksack River channel. Unprotected and crossing low ground in this stretch, Marine Drive is frequently flooded by low magnitude events (smaller than one-year floods). For instance, during the one-year period from the fall of 2001 through the summer of 2002, Marine Drive was flooded by six flood events that closed the road for at least 19 days. During the 2007-2010 MHMP update period, Marine Drive was closed at least 17 times with the longest continuous closure of 13 days and a total closure time of 54 days. Similarly, Marine Drive was closed for a total of more than 50 days during the 2010-2015 MHMP update period.

At flow levels near the 5-year flood event, the unleveed east bank across from Ferndale is overtopped with floodwaters. The floodwaters follow a natural overbank flow path through Hovander Park and eventually over Slater Road and Marine Drive. The floodwaters then generally threaten to overtop the low, poorly maintained levees surrounding the community of Marietta, on the east bank of the Nooksack River delta. At the level of 10-year to 15-year floods, levees on both banks of the river downstream from Ferndale are overtopped and large portions of the Lummi and Nooksack floodplains are inundated. The areas of inundation depend on where overtopping or breaching of the levees occurs and on the magnitude and duration of the flood. The Lummi River, levees along the Lummi River, and some roads in the floodplain can restrict floodwaters from spreading across the floodplain. Other roads that pass through the Reservation, including Slater Road, Haxton Way, and Marine Drive, have low elevation approaches to bridges that allow overbank flows to pass relatively unimpeded over the road surface (Whatcom County 1995a).

Major levee breaches have occurred along the lower Nooksack River during all large floods. As shown in Figure 5.6, the floods of 1951, 1971, 1975, 1989, 1990, 1995, and 1997 all caused levees to fail on both banks of the river (Whatcom County 1997a). These levee failures are most often caused by erosion when a levee section is overtopped. The levees may also weaken as the soils become saturated during extended floods, eventually resulting in failure of the levee. A levee failure relieves the pressure on downstream levees because the flow in the channel is reduced (Whatcom County 1995a).

In 1951, a breach occurred about a mile below the Ferndale Wastewater Treatment Plant, flooding the entire Nooksack and Lummi river floodplains. In subsequent major floods, levee breaches occurred further downstream and floodwaters were confined to the area between the Nooksack and Lummi rivers. A breach at Rayhorst Road was the main levee failure during the November 10, 1990 flood. Floodwaters from this breach contributed to the inundation of Haxton Way and eventually reached Lummi Bay (Whatcom County 1995a). A breach between Rayhorst

Road and Kwina Slough was the main levee failure during the January 1, 1997 flood, which occurred after two ice jams that were each a mile long backed up the Nooksack River above the Slater Road and Marine Drive bridges (Bellingham Herald 1997). This flood inundated Haxton Way for four days (Whatcom County 1997a). During the flood in January 2009, levees on the lower Nooksack River and on Kwina Slough were breached and overtopped in several places causing road closures on Slater Road, Haxton Way, Hillaire Road, Kwina Road, and Marine Drive. During these events the tribal boat launch for the fishermen was severely eroded and a pump station that transports water from the Nooksack to the hatcheries was damaged. Subsequent erosion to the river banks adjacent to the Marine Drive bridge has increased the risk to the foundations of the bridge.

Table 5.2 Nooksack River Flood Flows at the Ferndale Gage

Date	Flow (cfs)	Return Period (year)	Chance (percent/year)	Rank (1945 - 2015)
1815	Very High ¹	n/a ²		
1856	Very High ¹	n/a ²		
March 15, 1908	Very High ¹	n/a ²		
November 1909	Very High ¹	n/a ²		
December 30, 1917	Very High ³	n/a		
December 12, 1921	High ³	n/a		
February 27, 1932	Very High ^{1,3}	n/a ²		
January 25, 1935	Very High ⁴	n/a ⁴		
October 28, 1937	n/a ⁴	n/a ⁴		
100-year	62,800	100	1.0	
November 10, 1990	57,000 ⁵	59	1.7	1
November 24, 1990	56,600 ⁵	56	1.8	2
50-year	55,500	50	2.0	
February 10, 1951	55,000 ⁵	48	2.1	3
January 8, 2009	51,700	40	2.5	4
November 11, 1989	47,800 ⁵	22 ⁶	4.5	5
November 30, 1995	47,200 ⁵	23 ⁷	4.3	6
December 3, 1975	46,700 ⁵	23	4.3	7
November 25, 2004	42,300	13 ⁷	7.7	8
October 26, 1945	41,600 ⁵	12	8.3	9
January 5, 1984	41,500 ⁵	12	8.3	10
10-year	40,000	10	10.0	
October 21, 2003	39,600	9 ⁷	11.1	11
October 18, 2003	38,500	8 ⁷	12.5	12
December 13, 2010	38,300	8	12.5	13
January 31, 1971	38,100	8	12.5	14
March 20, 1997	38,100	8 ⁷	12.5	14
November 7, 2006	37,900	8 ⁷	12.5	15

Table 5.2 Nooksack River Flood Flows at the Ferndale Gage

Date	Flow (cfs)	Return Period (year)	Chance (percent/year)	Rank (1945 - 2015)
December 15, 1979	36,400	7	14.3	16
November 24, 1986	36,000 ⁵	6	16.7	17
November 4, 1955	35,000	6	16.7	18
January 11, 1983	34,200	5	20.0	19
January 19, 2005	30,900	4 ⁷	25.0	20
January 16, 1961	30,800	4	25.0	21
February 23, 2002	30,300	4 ⁷	25.0	22
April 30, 1959	30,200	4	25.0	23
February 25, 1986	29,900	3	33.0	24
December 27, 1980	29,700	3 ⁷	33.0	25
November 19, 2003	29,610	3 ⁷	33.0	26
January 5, 1969	28,100	3 ⁷	33.0	27
January 9, 2002	28,100	3 ⁷	33.0	27
November 27, 1949	27,500 ⁵	3	33.0	28
January 18, 2011	27,200	3	33.0	29
February 15, 1982	27,200	3 ⁷	33.0	29
November 20, 1962	26,000	2	50.0	30

¹Historical flood occurred before stream gage was established, flow estimated.

²Estimated return period greater than that of a 100-year flood.

³Estimated based on USGS data, presumably derived from high water marks.

⁴Recorded at Deming gage, which inaccurate; thus, estimated flow and return period is not reliable.

⁵Flow value influenced by upstream Everson-to-Sumas overflow.

⁶Value cited (Whatcom County 1995a) is out of sequence and may be in error.

⁷Values not found in Whatcom County 1995a were estimated by interpolation.

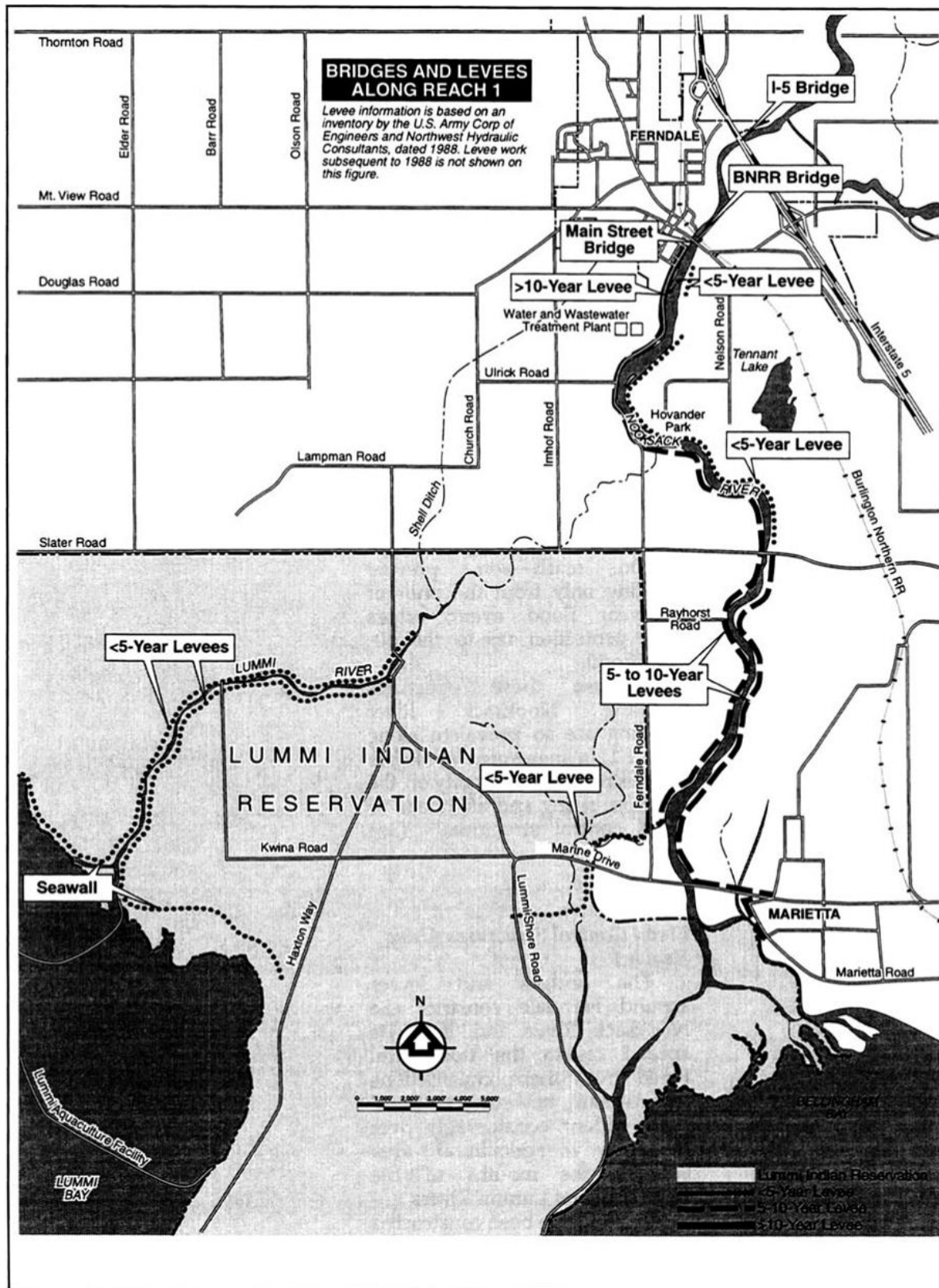


Figure 5.3 Levees along the Lower Nooksack River and Lummi River, 1988

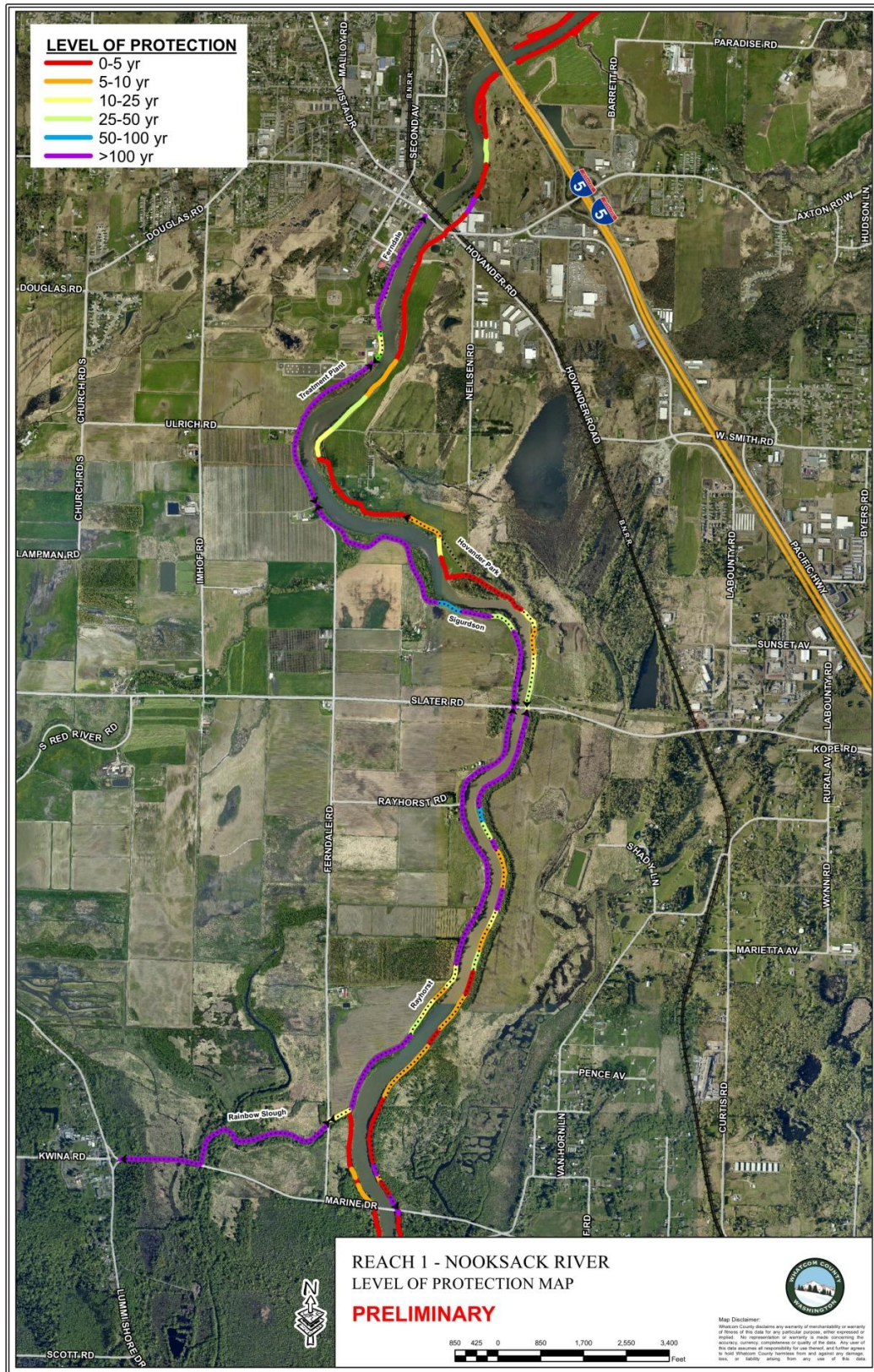


Figure 5.4 Modeled Level of Protection along the Lower Nooksack River

5.4.1.3. Coastal Floods

Coastal flooding in Puget Sound occurs most frequently during the winter months when the highest tides of the year combine with the storm surge and waves generated by winter windstorms. Several low-lying coastal areas of the Reservation are susceptible to flooding. The areas with the greatest probability of coastal flooding are the Sandy Point Peninsula, Gooseberry Point, and portions of the southeastern shoreline of the Lummi Peninsula (called Hermosa Beach). Several flood events have occurred in all of these areas over the past years.

The probability and potential damage of flooding along the western shore of the Sandy Point Peninsula are high because this region is exposed to a long reach of open water from the Strait of Georgia (up to a 117-mile fetch from the northwest). Winds blowing from the west to northwest over these longer fetches generate larger waves that, when combined with a high tide and storm surge, overtop the beach berms/dunes in undeveloped areas and the shore defense works in developed areas. As shown in Figure 5.8, where owners of shoreline parcels have constructed bulkheads and built houses, the combination of winds, wave build-up, and tides have resulted in substantial property damages as the forces of the wind and waves throw rocks and logs against structures and other obstructions. The flood hazards for the more frequent storms from the south and southwest are smaller because the fetches from these directions are much shorter. The flood hazard from northeast windstorms is less because the eastern shorelines of the Sandy Point Peninsula and the Lummi Peninsula are only exposed to short, shallow water fetches.

It is important to note that frequency and magnitude of coastal flooding is expected to increase in the future as sea levels rise in response to climate change. See Section 5.15 – Hazard Risk Assessment and Climate Change for more information.

5.4.2. Effects of Past Flood Events

This section describes the effects of past Nooksack River and coastal flood events on the Reservation.

5.4.2.1. Effects of Nooksack River Floods

The November 10, 1990 (Veteran's Day) flood was typical of a severe Nooksack River flood. In the three days before the flood peak, 10-12 inches of rain fell in the upper reaches of the watershed. Snowmelt above 2,500 feet was equivalent to several more inches of rainfall. Precipitation in the lowlands was six to seven inches (Corps 1991). This flood was the highest on record at the U.S. Geological Survey gauging station at Ferndale, approximately two miles north of the Reservation. With a calculated flow of 57,000 cubic feet per second (cfs), this event was estimated to be a 59-year flood (i.e., 1.7 percent chance of occurring in any given year) (Whatcom County 1995a). Figure 5.6 shows the approximate area of inundation during the November 1990 floods, including both the November 10 and November 24 flood events. Figure 5.5 presents photographs of the November 25, 1990 flood on the Reservation.

During the November 1990 floods, several major roads that provide access to and through the Reservation were inundated by floodwaters. These roads were: (1) Haxton Way, the major north-south connector, which also provides access to the Lummi Island ferry terminal, (2) Ferndale Road, (3) Lummi Shore Road (north and south of Kwina Road), (4) Hillarie Road, (5) Kwina Road (west of Haxton Way), (6) Marine Drive, the major access road to Bellingham from

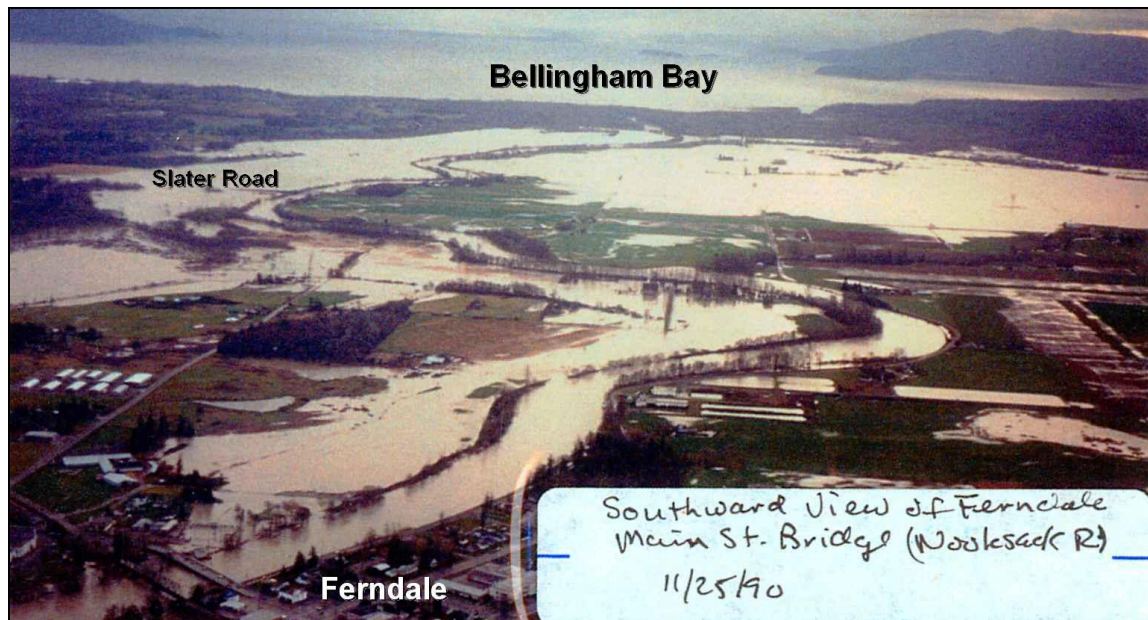
the Reservation, and (7) Slater Road, the major access road along the northern boundary of the Reservation. Marine Drive, Haxton Way, and Hillaire Road provide the only road access to the Lummi Peninsula and Gooseberry Point and during major floods, when these transportation routes are inundated by floodwaters, all land access to the peninsula is blocked. These three roads were closed for ten days during each of the two November 1990 floods. Medical emergencies during the road closures must be responded to by helicopter (Whatcom County 1997a). Road closures not only block land access, but also interrupt the ferry service between Gooseberry Point and Lummi Island. When necessary, the ferry is diverted to Bellingham, resulting in only four or five round trips per day to serve the island and peninsula. Over 2,000 people on the Lummi Peninsula and 750 people on Lummi Island would be affected by closure of these roads today (Whatcom County 1997a).

Inundation of homes and properties has caused significant damage on the Reservation during floods. Approximately 20 private residences, 2 businesses, and 2 natural resource production facilities were inundated by the 1990 floodwaters. Approximately 4,100 acres of land on the Reservation, most of which was in agricultural use, were flooded. Damage included deposition of sediment and debris on fields, erosion of topsoil near levee breaks and high velocity constriction points, and damage to fence lines and drainage structures in fields. Road damage included loss of road surfacing on North Red River Road and Marine Drive (Scott 1995).

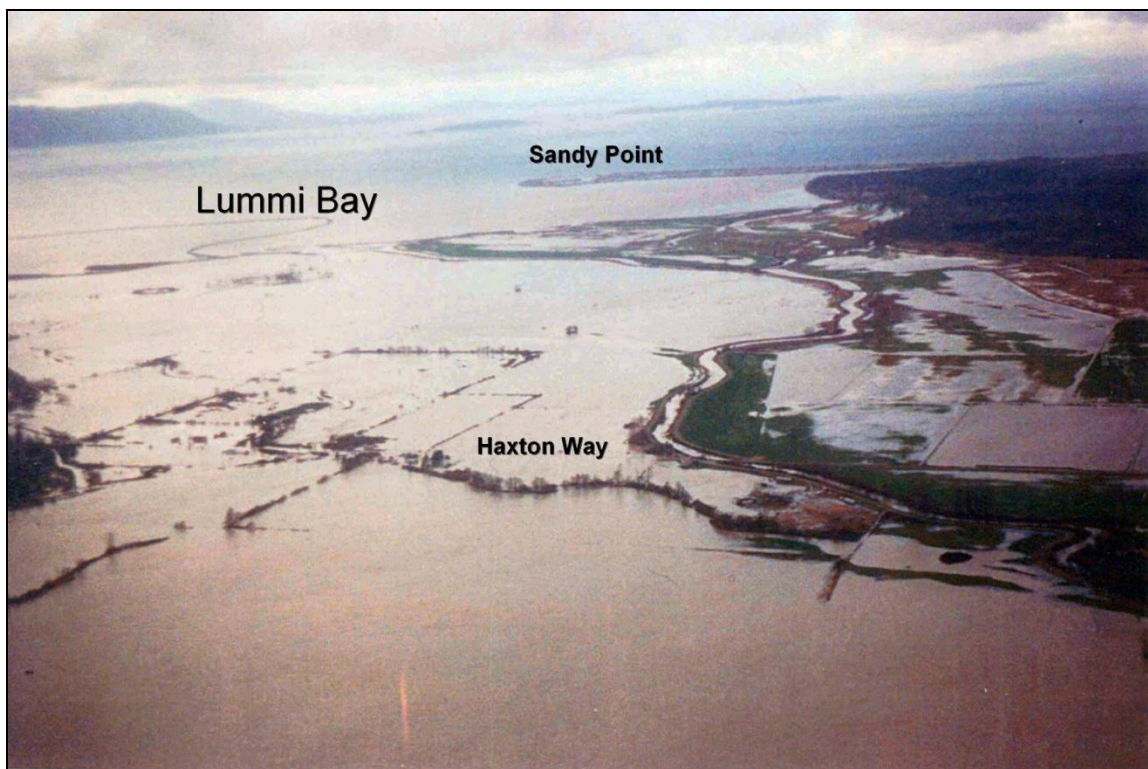
As with any major flood on the Nooksack River, the 1990 floods carried the possibility of a public health threat to Reservation residents due to the fact that any pollution entrained by floodwaters upstream must pass through or be deposited on the Reservation. Various sources of pollution exist in the floodplain upstream, including dairy waste lagoons, solid waste sites, fuel storage facilities, and wastewater treatment facilities.

Because of the proximity of Puget Sound and the Strait of Georgia, flood levels along the lower Nooksack River below Ferndale are influenced by tides. High tides fill the river channel in the delta, which both reduces the channel capacity and raises the level of the freshwater as it flows over the denser saltwater. Tidal effects on river discharge can cause flood flows to overtop levees and/or cause more water to spill over the banks of the river. During the flood on November 10, 1990, these effects raised the flood level at the river mouth several feet higher than what would have happened if the flood occurred several days earlier or later when tidal elevations were lower. Strong southwesterly winds may also have been a factor in this flood by raising the water level in the delta through wave setup (Whatcom County 1995a).

Another notable riverine flood event occurred in January 2009. This flood had an estimated 40-year return period and resulted in a federal disaster declaration for January 6-16, 2009. Effects to the Reservation included levee failures and road closures, the closure of shellfish beds, damage to the aquaculture pond tide gates, and other hatchery and Natural Resources Department equipment.



(a) View from Ferndale along the Nooksack River to Bellingham Bay



(b) View along the Lummi River to Lummi Bay

Figure 5.5 Flooding on the Reservation November 25, 1990

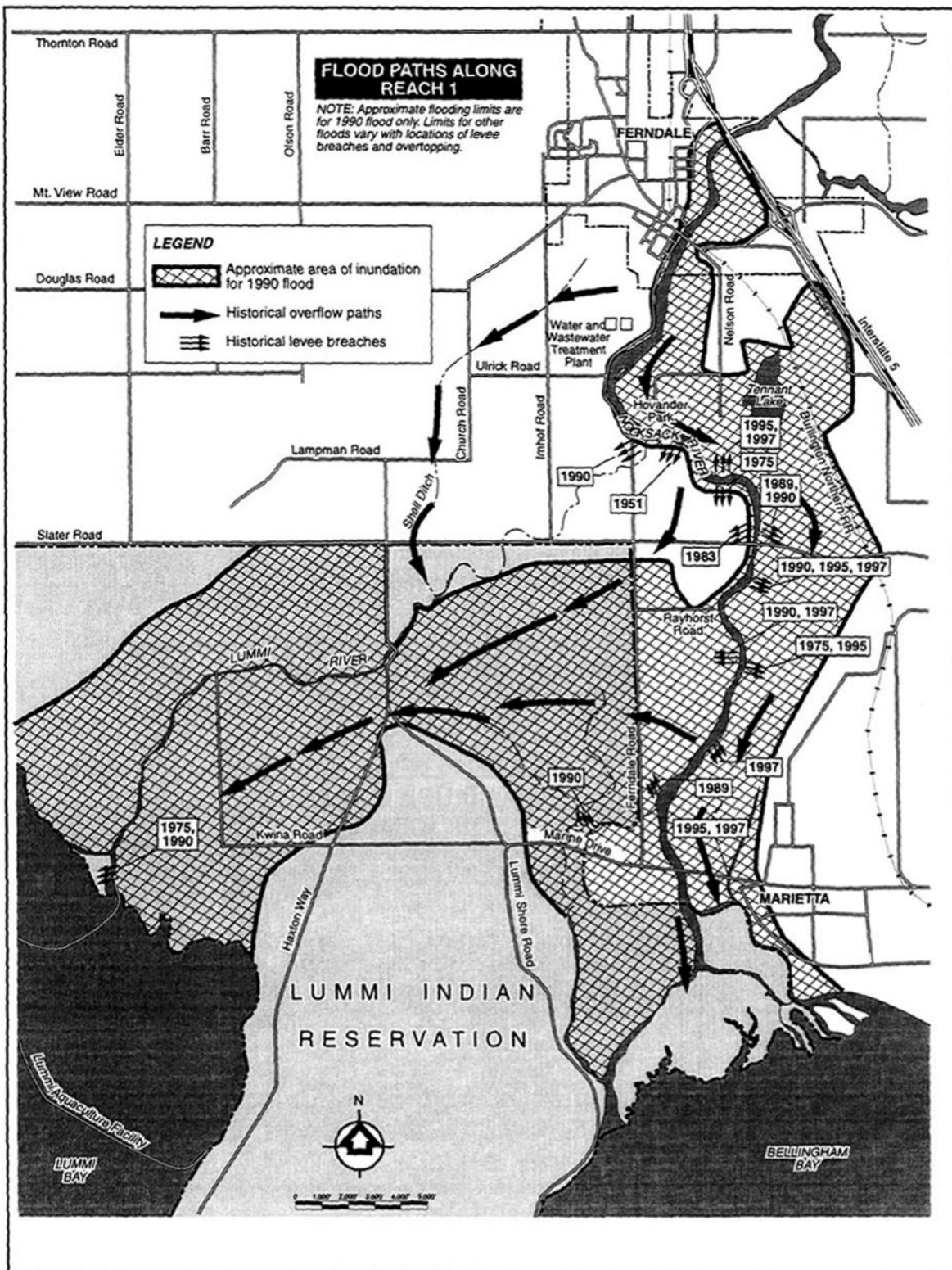


Figure 5.6 Area of Inundation in November 1990 and Historical Levee Breaches

5.4.2.2. Effects of Coastal Floods

Coastal flooding in the Gooseberry Point area at the southwestern end of the Lummi Peninsula has closed roadways (e.g., Haxton Way and Lummi View Drive) and flooded 15 to 20 homes along the west shoreline. Most recently, coastal flooding at Gooseberry Point occurred during December 2000, December 2001, January and November 2003, February 2006, January 2010, and December 2011. Along the southeastern shoreline of the Lummi Peninsula, coastal flooding has inundated stretches of Lummi Shore Road and portions of some properties and structures in the Hermosa Beach area that lie landward of the road. On January 2, 2003, water flowed over Haxton Way and up to two feet of water pooled around several homes along the Gooseberry Point shoreline. This flood also significantly eroded the shoulder of Lummi Shore Road in the Hermosa Beach area and deposited logs and other debris that blocked the road. Flooding on February 4, 2006 had similar effects and caused water to pond near the Fisherman's Cove Mini-Mart and nearby homes, removed a portion of Lummi Shore Road near the portage, and deposited logs and debris on the road. Figure 5.7 presents photographs of the Haxton Way area on Gooseberry Point and of Lummi Shore Road shortly after the flooding occurred in January 2003.

Small flood events along the Sandy Point Peninsula (and probably, on some of these occasions, at the other vulnerable Reservation locations) have occurred most recently in December 1995, winter 1996, November 2000, December 2001, January 2003, October 2003, January 2005, March 2005, January 2006, February 2006, December 2006, January 2010, December 2011, and December 2014. During these smaller storm surge events, water generally overwashed bulkheads, flowed through yards, and deposited beach debris on Sucia Drive, which lies east of the houses that line the west shoreline of the peninsula.

Larger, more damaging coastal flood events along the Sandy Point Peninsula occurred on March 30, 1975, in December 1982, on December 4, 1993, and on December 15, 2000 (Whatcom County 2001). The March 1975 flood event caused damage along the Reservation and Whatcom County shorelines, with the greatest damage occurring along the Sandy Point Peninsula. Although the 1975 storm was a major windstorm, it occurred before substantial residential development occurred along the Sandy Point Peninsula. The December 1982 event also affected both Reservation and Whatcom County shorelines, with damage occurring to homes along the Sandy Point Peninsula and at Birch Bay (about eight miles north of the Reservation), where roads and a golf course were also flooded. On December 4, 1993, sustained winds of 40 to 50 mph, with gusts measured to 59 mph, combined with a high tide to produce large breaking waves that pounded bulkheads and homes along the west shore of the Sandy Point Peninsula and the Neptune Beach area. Waves were estimated to be 10 to 14 feet high and breaking or rising over bulkheads to the second story level of shoreline homes. Entrained logs smashed into bulkheads and through the patio door of at least one home. Several homes near the south end of the Sandy Point Peninsula (north of the entrance channel) were flooded with water to a depth of more than one foot and several families were evacuated from their homes. The intersection of Sucia Drive and Patos Drive was flooded to a depth of more than two feet and covered with driftwood, isolating the residents to the south. The north end of Sucia Drive was also flooded with several inches of water near the curve onto Beach Way, but remained passable. Damage costs were expected to be thousands of dollars (Sandy Point News Review 1993).

During the December 2000 event, sustained winds of up to 70 mph (Bellingham Herald 2000) generated large waves moving due east, directly into the western Sandy Point/Neptune Beach shoreline along the Strait of Georgia. The high winds combined with a high tide of 10.5 feet (according to the tide tables, the highest tide of 2000 in the Sandy Point area was 10.6 feet) and resulted in wave build-up and in waves crashing into and rising an estimated 10 to 20 feet over the bulkheads lining the Sandy Point Peninsula shoreline. The battering by these waves and associated logs and beach cobbles, which continued for three to four hours during the tide peak, damaged or destroyed bulkheads and eroded properties behind the bulkheads. Many homes suffered water damage, some with a layer of beach cobbles and gravel covering their floors. Several homes had debris (e.g., logs and a large chunk of cement) hurled into them, breaking windows, doors, and walls. A field survey of the 35 homes immediately north of the marina entrance channel (near the south end of the Sandy Point Peninsula) found the following damage: 6 failed bulkheads, 7 damaged bulkheads, 18 bulkheads with settled rip-rap, 6 flooded houses, 9 damaged houses, 16 destroyed decks, and all 35 properties were flooded and contained overwash debris (Johannessen 2000a). A total of approximately 60 homes/properties along the Sandy Point Peninsula and Neptune Beach had some damage. Residents said the damage from this storm, estimated to be a 15-year to 25-year flood event, was slightly worse than that of the 1975 or 1982 storms (Whatcom County 2001). The total cost of damages from this flood was estimated to be approximately \$750,000 (Whatcom County 2002). Photographs of the damage to some homes are shown in Figure 5.8.



(a) Gooseberry Point: View North from Haxton Way/Lummi View Drive Intersection (left) and South from Haxton Way (right)



(b) Hermosa Beach: View North along Lummi Shore Road (left) and West from Lummi Shore Road (right)

Figure 5.7 Flood Effects at Gooseberry Point and Hermosa Beach, January 2, 2003



(a) 9th to 12th Houses North of Marina Channel Entrance (View East)



Sandy Point Flood Damage
December 15, 2000

(b) Destroyed Bulkhead and Deck (Several Hours after Peak Waves)

Figure 5.8 Storm Damage along Sandy Point, December 15, 2000

5.4.3. Flood Vulnerability Assessment

The vulnerability of the Reservation to riverine and coastal flooding is described in the following two sections. Figure 5.10 shows the estimated vulnerabilities to flooding in the six assessment areas on the Reservation. Table 5.3 summarizes the vulnerability to flood damage and potential losses to areas and structures on the Reservation.

5.4.3.1. FEMA Flood Zones

The Federal Emergency Management Agency (FEMA) first issued Flood Insurance Rate Maps (FIRMs) for the Reservation on January 16, 2004; several panels were later revised and reissued by FEMA on November 16, 2007. Updates to the current FIRMs for the Reservation are underway. The FIRMs describe areas with flood hazards of different inundation and water velocity levels (Figure 5.9). As previously described, the Special Flood Hazard Area (SFHA) is the area subject to inundation by the 1 percent annual chance flood event (also called the 100-year flood or the base flood). Within the SFHA on the Reservation are FEMA flood zones labeled AE, AO, V, and VE. Definitions of these flood zones are as follows: (1) Zone AE are areas where base flood elevations have been determined, (2) Zone AO are areas where flood depths of one to three feet are expected (usually sheet flow on sloping terrain), (3) Zone V are coastal flood areas with velocity hazards (i.e., wave action), but where no base flood elevations have been determined, and (4) Zone VE are coastal flood areas with velocity hazards where base flood elevations have been determined. Also shown in Figure 5.9 are areas labeled Zone X, these areas have been determined to be outside of the SFHA and theoretically should not be subject to inundation during a 100-year flood event. The FIRMs informed the evaluation of flood hazards and vulnerabilities in the different MHMP assessment areas.

5.4.3.2. Nooksack River Flood Vulnerabilities

Nooksack River floods impact the six MHMP assessment areas to varying degrees. The Floodplain assessment area is most affected by actual inundation, while other areas like the Lummi Peninsula and Gooseberry Point are isolated during a major riverine flood event. Although access is reduced, the Sandy Point Peninsula, the Northwest Upland, and Portage Island are either not affected by or only marginally affected by a river flood. The main physical effects of large Nooksack River floods on the Reservation are damage to flood control structures and residences, erosion of agricultural areas and roads, deposition of sediment and pollutants, and road closures. The floodplain also contains areas of cultural significance that would be impacted by a flood.

The Silver Reef Hotel, Casino & Spa and the Lummi Mini-Mart and gas station are located on a tribal trust parcel in the Floodplain assessment area. Both of these structures comply with the Lummi Nation Flood Damage Prevention Code (LCL Title 15A) and are constructed so that the elevation of the lowest floor is at least one foot above the base flood elevation, which will theoretically only be reached in a 100-year flood event. These economically important enterprises are impacted by severe flooding that closes or reduces site access, leading to a loss of income. For instance, when both Slater Road and Marine Drive are closed, access to the Reservation is maintained by way of detours through the City of Ferndale to the north. This detour has been estimated to add an additional 40 minutes to travel times on average.

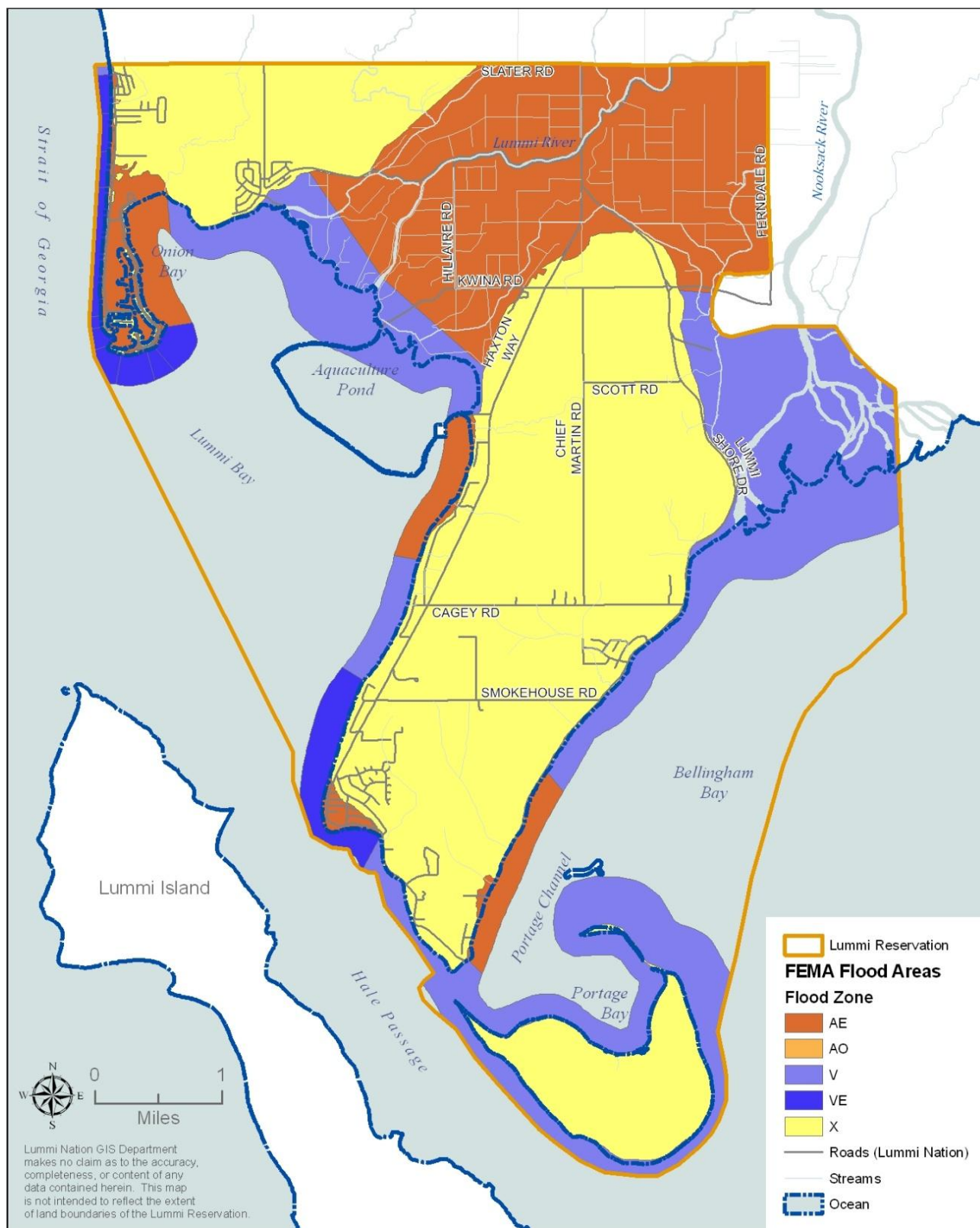


Figure 5.9 Federal Emergency Management Agency (FEMA) Flood Zones

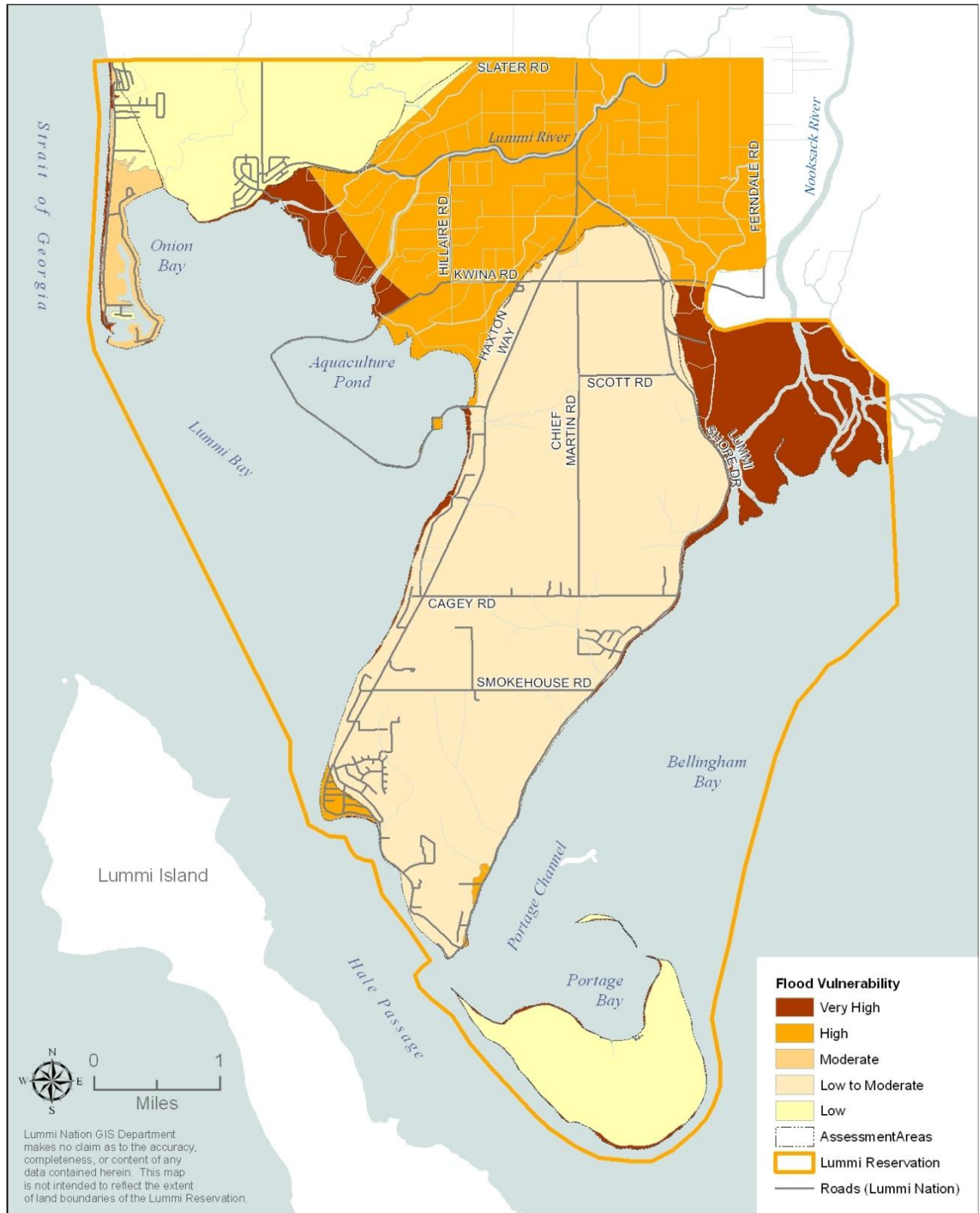


Figure 5.10 Estimated Flood Vulnerabilities in Reservation Areas

The Lummi Peninsula and Gooseberry Point assessment areas can become entirely isolated during major flood events that close all access roads. The isolation has a large impact on public health and safety since the only remaining transportation is by boat or helicopter. The small ferry serving Lummi Island from Gooseberry Point is diverted from Lummi Island to provide transportation to Bellingham, but with only four round trips each day, capacity is low. Although the Lummi Nation Police Department and Fire District 8 stations are on the Lummi Peninsula, extra support for emergency situations is not available in a timely manner during flood-induced road closures. Medical emergencies needing immediate transportation require a helicopter. The road closures also have a large economic effect on the community. Because many employees cannot get to work, this isolation affects tribal government offices, the health clinic, tribal schools, the Northwest Indian College, and other businesses located on the Lummi Peninsula. In addition, many residents of the Lummi Peninsula lose income because they cannot get to work off-Reservation. While the residents of the Northwest Upland and Sandy Point Peninsula are inconvenienced by road closures due to flooding in the floodplain, these areas remain accessible by road.

River floods also harm the finfish and shellfish fisheries based in the Floodplain assessment area that are an important commercial income and subsistence resource. Floods make it impossible to fish the river for the duration of the high water, and the pollutants entering the river and the delta during a flood can also cause the closure of the extensive shellfish beds in Lummi Bay and Portage Bay. Floods cause damage to fishing equipment, infrastructure like boat access points, and the salmon and shellfish hatcheries in Lummi Bay, as well as the tribal aquaculture facility known as the “Seapond.”

5.4.3.3. Coastal Floods Vulnerabilities

The primary vulnerability to coastal floods on the Reservation is damage to residential buildings, shore defenses, and roads. Coastal floods also have the potential to damage or destroy tribal cultural resources, particularly through coastal erosion. The assessment areas affected by coastal floods are the Sandy Point Peninsula, Gooseberry Point, the roads along the shorelines of the Lummi Peninsula, and beaches on Portage Island.

The Sandy Point Peninsula is more vulnerable to coastal flooding in some areas than in others. The western shoreline has a very high vulnerability to coastal floods due to the low-lying topography and the long fetch distances over the Strait of Georgia. Many shoreline properties have bulkheads, decks, and/or homes located in the coastal flood zone with velocity hazards (i.e., wave action) as identified by FEMA. This vulnerability could be increasing because the beach along the western shoreline of the Sandy Point Peninsula has been eroding and has become steeper in front of the now nearly continuous line of bulkheads (Johannessen 2000b, 2003). A steeper beach allows more wave energy to reach the bulkheads, without being dissipated by a gradual wave run-up. In addition, the vertical bulkheads direct the wave energy upward, which results in higher base flood elevations in this area than along natural beach slopes (FEMA 2003d).

The eastern shoreline and inland areas of the Sandy Point Peninsula have a more moderate level of vulnerability compared to the western shoreline areas. These properties are exposed to a fetch that is substantially shorter than that of the western shoreline (up to 1.6 miles from the east or 2.9 miles from the southeast across shallow Lummi Bay). Hence the velocity hazard is less and

most of the structures are not as vulnerable to structural damage during a 100-year flood event. However, if homes on these properties are not elevated above the base flood elevation (BFE) identified on the FIRM, they will be subject to shallow flooding during a 100-year coastal flood event. Additionally, there are numerous boats that are anchored in the Sandy Point Marina that can potentially be harmed by the high winds accompanying a coastal flood surge. The Sandy Point Fire Station is located on the east side of Sucia Drive in an area identified as a shallow flooding zone.

In the Gooseberry Point assessment area, the LIBC Fish Buying Station and Pier, the LCC Dock and Dock Office, and the Whatcom County Ferry Terminal are located within the very high vulnerability flood hazard area, while all other facilities and residences are located in a high vulnerability zone.

In the Hermosa Beach area along the southeastern shoreline of the Lummi Peninsula, several properties are in the 100-year flood area and an approximately 1.5 mile stretch of Lummi Shore Road is susceptible to flooding and damage from waves and erosion (as occurred in January 2003, November 2003, and February 2006). Some of the road shoulders damaged in January 2003 were part of the Lummi Shore Road project, a major shoreline and bluff stabilization project designed to protect Lummi Shore Road and landward properties from further coastal erosion. In 2006, a section of Lummi View Drive near the tombolo to Portage Island was moved inland and away from the shoreline.

The Portage Island assessment area has low-lying shoreline areas that are vulnerability to coastal floods.

As with riverine floods, coastal flood events also harm tribal fisheries. The fisheries may be closed during the event, and damage to equipment and infrastructure, including the salmon and shellfish hatcheries and the aquaculture pond, can have long-term effects on the income and the ceremonial and subsistence harvest by tribal members.

5.4.4. Potential Flood Losses

Table 5.3 lists the flood vulnerability levels present in each assessment area, the number of structures at risk, and the potential structure and contents losses to floods. Potential structure losses due to flooding were estimated to be 50 percent of the total structure value (FEMA 2001a). Contents losses due to flooding were estimated to be 50 percent of the insured contents value or 50 percent of the structure value, as appropriate (FEMA 2001a). It is recognized that this method has limitations. For instance, it does not take into account the depth to which each structure is expected to be flooded during the 100-year flood event. Additionally, as described in Section 5.1 – Assessment Areas, many of the reported structure values were obtained from the Whatcom County Auditor's Office and may thus underestimate replacement costs as assessed values are typically lower than market value.

5.4.4.1. Nooksack River Floods Losses

The U.S. Army Corps of Engineers (Corps) estimated an average annual flood damage cost of \$2.5 million (1992 dollars) for the entire Nooksack River floodplain (Corps 1993). For the area downstream of Ferndale to the mouth of the river, not including the Marietta community, the estimated annual damage cost was \$475,000 (1992 dollars), with most of these costs due to

damaged flood control facilities and agricultural areas (Corps 1993). As shown in Table 5.3, a major event resulting in losses totaling half of all structure and contents values in the Floodplain assessment area of the Reservation would cost approximately \$6.2 million (2014 dollars). These estimated losses do not include costs associated with either the Silver Reef Hotel, Casino & Spa or the Lummi Mini-Mart because both of those structures comply with the Lummi Nation Flood Damage Reduction Code (LCL Title 15a) and have the lowest floor elevated at least one foot above the base flood elevation (i.e., 100-year flood event).

The economic costs on the Reservation of lost business and lost wages would add substantially to the costs cited by the U.S. Army Corps of Engineers in 1993. The Silver Reef Hotel, Casino & Spa and Lummi Mini-Mart and gas station would lose all customers during a large flood that closed Slater Road and Haxton Way. The LIBC and other tribal entities on the Lummi Peninsula, many of whose employees live off the Lummi Peninsula, would be affected. Many other residents on the peninsula would not be able to get to jobs off the Reservation. Other substantial losses would be the loss of subsistence harvest due to the closure of the fisheries on the Reservation during a flood, as well as lasting damage to fisheries resources. These losses are difficult to enumerate as the impact on the harvest depends on the season and the harvest quota in the specific year that a flood event takes place.

5.4.4.2. Coastal Floods Losses

Given the current vulnerability of the Sandy Point Peninsula, an extreme flood event in this area could result in a total loss of many of the structures on the peninsula. As shown in Table 5.3, a major event resulting in losses totaling half of all structure and contents values on the peninsula would cost approximately \$44 million in year 2014 dollars. This does not include potential damage to the boats in the Sandy Point Marina. Comparable losses and damages to structures in the Gooseberry Point area would total nearly \$14 million. Additional costs would result from the displacement of people from their homes while repairs occurred to make them habitable again. Further losses include losses to the commercial and subsistence harvest of finfish and shellfish due to closure of fisheries and mid- to long-term damages to fisheries resources as described for river floods.

Table 5.3 Vulnerability and Potential Losses of Structures to Floods

Assessment Area	Estimated Vulnerability	Number of Structures	Structure Losses ¹	Contents Losses ²	Location/Comment
Lummi Peninsula	Very High	8	\$618,869	\$309,435	▪ Roberson Road area
	High	14	\$485,757	\$142,879	▪ Hermosa Beach area
	Low to Moderate	1,249	n/a	n/a	▪ Isolation due to closed roads threatens public safety ▪ Economic impacts to employers and employees
Floodplain	Very High	9	\$501,967	\$150,984	
	High	50	\$4,267,039	\$1,295,060	▪ Silver Reef Hotel, Casino & Spa and Lummi Mini-Mart not included, flood mitigation measures in place
Northwest Upland	Very High	1	\$43,456	\$21,728	
	Low	422	n/a	n/a	▪ Road detours are potential inconvenience
Portage Island	Very High	0	n/a	n/a	▪ No structures
	Low	0	n/a	n/a	▪ No structures
Sandy Point Peninsula	Very High	84	\$6,578,723	\$3,289,361	▪ Western shoreline is highly vulnerable
	Moderate	317	\$22,982,414	\$11,291,207	▪ Eastern and southern shorelines have lower vulnerability
	Low	99	n/a	n/a	
Gooseberry Point	Very High	5	\$7,363,980	\$28,285	▪ LIBC Fish Buying Station and Pier, LCC Dock and Dock Office, Whatcom County Ferry Terminal
	High	126	\$4,367,352	\$2,022,208	
Total		2,384	\$47,209,557	\$18,551,147	▪ Total Flood Losses: \$65,760,704

¹Potential structure losses estimated as 50 percent of the total structure value

²Potential contents losses estimated as 50 percent of the total contents value

5.5. Earthquakes

Oral histories and geologic records show that the Reservation region has a history of large earthquake events. In the following sections, earthquakes in the Pacific Northwest, past earthquake events, earthquake vulnerability, and potential earthquake losses on the Reservation are described.

5.5.1. Profiles of Earthquake Hazards

This section describes earthquake hazards, earthquake measurements, and earthquake types.

5.5.1.1. Types of Earthquake Hazards

An earthquake is ground shaking that is caused by the sudden release of slowly accumulated pressure within the crust of the Earth or within the tectonic plates below the Earth's crust. Earthquakes can trigger soil and other geologic failures that contribute to the total damages,

including landslides, slope failures, lateral spreading, slumping, and liquefaction (Oregon 2000b, GSC 2002a). Ground shaking, landslides, liquefaction, and amplification are the primary specific hazards associated with earthquakes affecting the Reservation. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, earthquake magnitude, and the type of earthquake (Oregon 2000b, Clackamas County 2002). These four hazards are described below:

- **Ground Shaking:** Ground shaking is the motion caused by seismic waves generated by an earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter. Buildings on poorly consolidated and thick soils will typically have more damage than buildings on consolidated soils and bedrock.
- **Earthquake-Induced Landslides:** Earthquake-induced landslides are secondary earthquake hazards that result from ground shaking. They can destroy homes and the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Most vulnerable are developed areas with steep slopes, which occur on the Reservation above Neptune Beach and along the east and west shores of the Lummi Peninsula.
- **Liquefaction:** Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. Liquefaction results in the loss of soil strength and the ability of the soil to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures. Areas vulnerable to liquefaction on the Reservation include the Sandy Point Peninsula, Gooseberry Point, and the riverine floodplain. Although stone columns were used to minimize the liquefaction potential at the Silver Reef Hotel, Casino, & Spa, such protective measures were not taken for other structures (i.e., residences, Lummi Mini-Mart) in these areas.
- **Amplification:** Soils and soft sedimentary rocks near the earth surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. The amount of amplification is influenced by the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk. Amplification can also occur in areas with deep, sediment-filled basins and on ridge tops.

5.5.1.2. Measurement Scales of Earthquakes and Earthquake Damages

The sizes of earthquakes are described using several methods that quantify the magnitude and intensity in different ways. A common measure is the Richter Magnitude Scale, a mathematical tool developed in 1935 to compare earthquakes. The magnitude of an earthquake is quantified on the Richter Scale based on the logarithm of the amplitude of waves recorded by seismographs. For example, a magnitude of 5.3 might be computed for a moderate earthquake, and a strong earthquake might have a magnitude of 6.3. Because of the logarithmic basis of the Richter Scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude (i.e., magnitude 8 is 100 times greater than magnitude 6). As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the lower number (USGS 2003a). The Richter Scale is not used to express damage. An earthquake in a densely populated area that

results in many deaths and considerable damage may have the same magnitude as an earthquake in a remote area that does little to no damage.

Recently, another scale called the Moment Magnitude Scale (MMS) has been devised for more precise study of earthquakes. The Moment Magnitude Scale measures the energy released at the source of the earthquake, and is also determined from measurements on seismographs. Moment magnitude measurements are thought to describe the strength of large earthquakes more accurately than the Richter Scale (USGS 2003a). Another metric is the Modified Mercalli Intensity (MMI), which measures the strength of shaking produced by an earthquake at a certain location; it is determined from effects on people, human structures, and the natural environment. The MMI value for each earthquake varies from location to location (USGS 2002b). Table 5.4 shows the relationship between moment magnitudes and MMI levels of earthquakes, as well as the associated perceived motion and level of damage that are typically observed at locations near the epicenter of an earthquake (USGS 2002b). Commonly, sites on soft ground or alluvium have intensities two to three units higher on the Modified Mercalli Intensity scale than sites on bedrock. This is important on the Reservation because the floodplains of the Nooksack and Lummi rivers are comprised of alluvium and the remainder of the Reservation uplands are comprised of glacial material.

One measure of the strength of earth movement in an earthquake is peak ground acceleration (PGA), which is expressed as a percentage of the force due to gravity. For example, a PGA of 20 represents acceleration equal to 20 percent of the force due to gravity. The PGA is the maximum acceleration of the ground during the course of the earthquake motion, and is related to the force a building will receive during an earthquake. This force will vary between locations based on the distance from the earthquake epicenter and on the nature of the soils or rock in a location. Table 5.5 shows the correlation between the Modified Mercalli Intensity scale, PGA values, perceived shaking, and potential damage (from FEMA 2001a). A PGA of 9 to 18 would be perceived as strong shaking and would potentially result in light overall damage (FEMA 2001a). A PGA of about 10 may be the approximate threshold of damage to older (pre-1965) dwellings or dwellings not made to resist earthquakes (USGS 2003b). However, this standard value cannot be applied to all buildings because: (1) the relationship between intensity and peak acceleration is quite variable, (2) for more distant sites, longer duration ground motions may cause damage at lower acceleration values, and (3) buildings differ greatly in their vulnerability (USGS 2003b).

Even though there are several metrics to describe earthquakes, the more common Richter Scale is used to describe the magnitude of earthquakes in the remainder of this section, unless specified otherwise.

Table 5.4 Relationship Between Moment Magnitude Scale (MMS) and Modified Mercalli Intensity (MMI)

MMS	MMI	Description of Perceived Motion and Level of Damage
1.0 – 3.0	I	I. Not felt except by a very few people under especially favorable conditions.
3.0 – 3.9	II – III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
4.0 – 4.9	IV – V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0 – 5.9	VI – VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
6.0 – 6.9	VIII – IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
≥ 7.0	≥ X	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level distorted. Objects thrown into the air.

Table 5.5 Modified Mercalli Intensity (MMI), Peak Ground Acceleration (PGA), and Potential Effects

MMI	PGA	Perceived Shaking	Potential Damage
IV	1.4 – 3.9	Slight	None
V	3.9 – 9.2	Moderate	Very Slight
VI	9.2 – 18	Strong	Slight
VII	18 – 34	Very Strong	Moderate
VIII	34 – 65	Severe	Moderate to High
IX	65 – 124	Violent	High
X	> 124	Extreme	Very High

5.5.1.3. Types of Earthquakes

The Pacific Northwest is located above a convergent plate boundary where the Juan de Fuca and North American tectonic plates meet. This boundary, called the Cascadia Subduction Zone (CSZ), extends from British Columbia to northern California (GSC 2002a). Earthquakes along the CSZ are infrequent but high magnitude. Additionally, the Puget Sound region is underlain by a large and complex system of faults that can also produce damaging earthquakes; although these smaller faults produce lower magnitude events. There are three characteristic types of earthquakes in the Pacific Northwest: (1) subduction zone earthquakes (a.k.a., megathrust earthquakes), (2) intraplate earthquakes (a.k.a., Benioff zone earthquakes), and (3) crustal earthquakes. Each earthquake type is summarized in Table 5.6 and illustrated in Figure 5.11.

Geologic evidence indicates that the Cascadia Subduction Zone (CSZ) has generated 13 megathrust earthquakes over the last 6,000 years, the most recent of which occurred approximately 300 years ago. The 1700 Cascadia megathrust earthquake is thought to have been magnitude 9.0 or greater (similar to recorded megathrust earthquakes in other regions, such as the 1960 9.5 magnitude earthquake in Chile, the 1964 9.2 magnitude earthquake in southern Alaska, the 2004 9.0 magnitude earthquake in the Indian Ocean, the 2011 9.0 earthquake off the coast of northeastern Japan). The average recurrence interval of these large subduction zone earthquakes is approximately 500 years, with intervals between events as small as 200 years and as large as 1,000 years. Intraplate earthquakes occur deep within the oceanic Juan de Fuca plate as it subducts beneath the North American plate and can reach magnitudes of up to 7.5. The Nisqually Earthquake on February 28, 2001 in Washington State was a magnitude 6.8 intraplate earthquake that produced ground shaking felt from Vancouver, British Columbia, Canada to Coos Bay, Oregon and east to Salt Lake City, Utah. The most common type of earthquake in the region is the shallow crustal earthquake. Although crustal earthquakes occur relatively frequently, they are also usually relatively mild. Several active fault lines pass through western Washington, some of which may pass near or through the Reservation (Figure 5.12) (Barnett et al. 2007; Easterbrook et al. 2000). Because crustal earthquakes occur more frequently and can be much closer to the Reservation, they likely represent the largest earthquake hazard to the Lummi Nation (GSC 2002a).

Table 5.6 Types of Earthquakes in the Pacific Northwest¹

Type	Depth	Frequency	Location of Epicenter	Comment
Subduction Zone	Intermediate depth	200 to 1,000 years apart (occur once every 500 years on average)	Most likely under the ocean off the Pacific Coast	<ul style="list-style-type: none"> • Potentially Magnitude 9+ • Not close to Reservation • A minute or more of strong shaking • Large aftershocks
Intraplate	Relatively deep (25-40 miles)	Decades apart	Anywhere in the region (western Washington, Cascade Mountains)	<ul style="list-style-type: none"> • Potentially magnitude 7.5 • Potentially near the Reservation • Few or no aftershocks • E.g., Nisqually Earthquake
Crustal	Relatively shallow (6-12 miles)	<ul style="list-style-type: none"> • Magnitude <4: several per year • Magnitude >6: decades or more apart 	Many faults in the region, including two that pass within a few miles of the Reservation	<ul style="list-style-type: none"> • Potentially magnitude 7 • Potentially near the Reservation • Most common, but usually mild • Aftershocks common

¹Clackamas County 2002; Geological Survey of Canada (GSC) 2002a, GSC 2002b

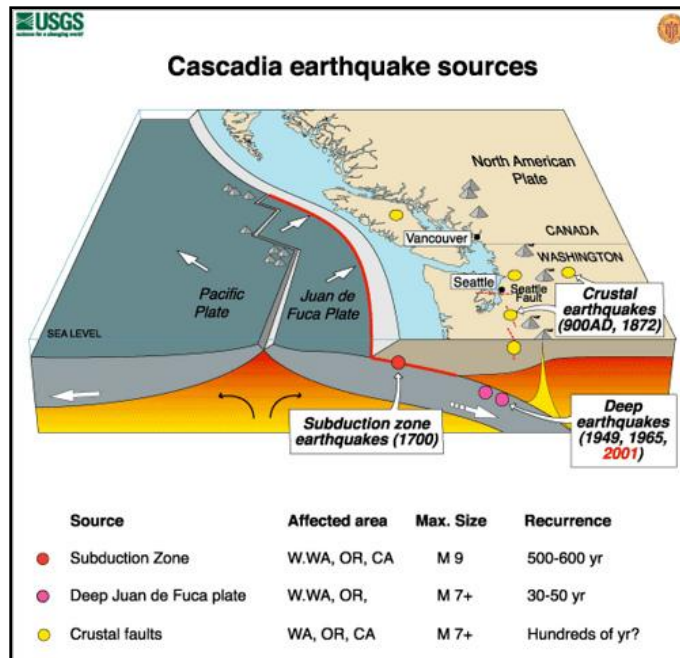


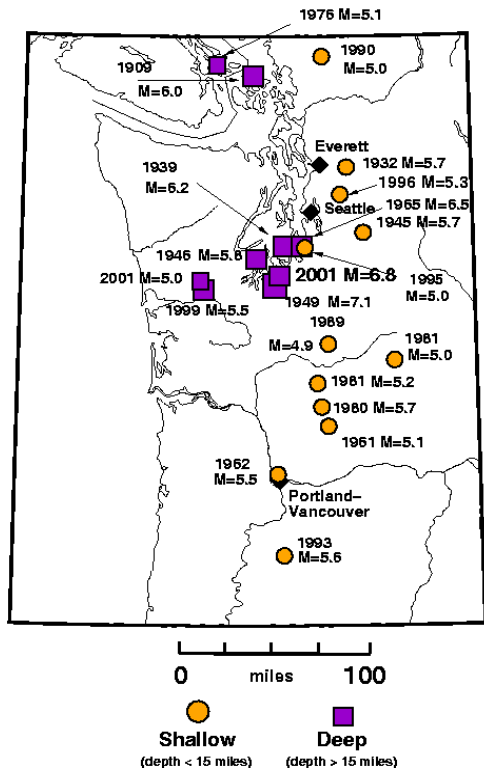
Figure 5.11 Types of Earthquakes in the Pacific Northwest (USGS 2002a)

5.5.2. Effects of Past Earthquake Events

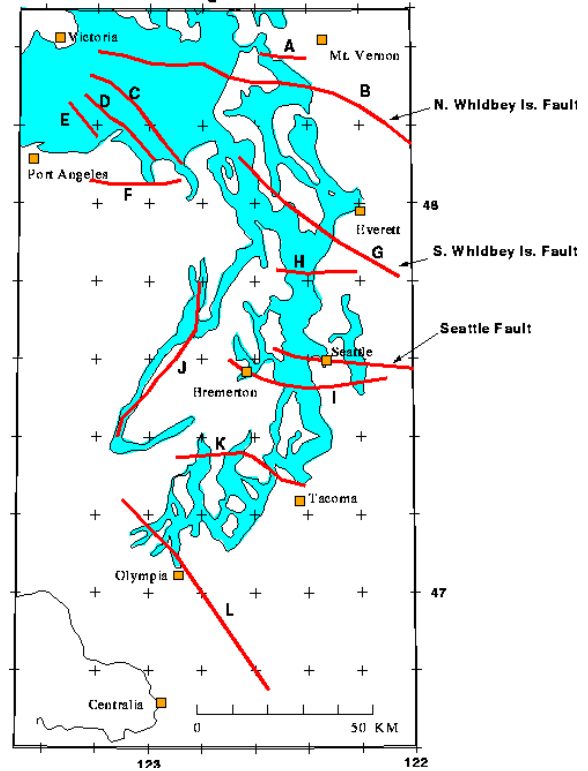
Many earthquakes occur in the area of the Reservation. Most are too small to be felt, but relatively rare large earthquakes could potentially cause massive social, economic, and environmental impacts. Figure 5.12 shows the locations of recorded earthquakes in the Reservation area and Table 5.7 summarizes the largest recorded earthquakes in the region. The remainder of this section describes notable earthquakes that have impacted the Reservation in the past.

5.5.2.1. Subduction Zone Earthquakes

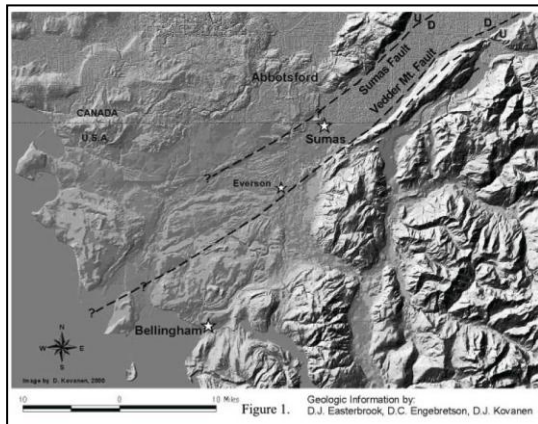
The most recent Cascadia Subduction Zone earthquake occurred in 1700 and was estimated to be a magnitude 9.0. The undersea Cascadia thrust fault ruptured along a 1,000 kilometer length, from the middle of Vancouver Island to northern California, producing tremendous shaking and a large tsunami that swept across the Pacific Ocean. In fact, this earthquake was identified using Japanese records of the tsunami, which did considerable damage in Japan, as well as geologic evidence in Washington State (Krajick 2005). Along the Pacific Northwest coast, the earthquake raised some land elevations up to five meters, caused underwater landslides, and caused the subsidence and drowning of coastal old growth trees. Oral traditions of the native peoples of Vancouver Island indicate that the tsunami destroyed a winter village at Pachena Bay on the west coast of Vancouver Island, killing all the inhabitants. Oral traditions also indicate that the ground shaking damaged houses in the Cowichan Lake region of south central Vancouver Island, which was reportedly so violent that people could not stand and so prolonged that it made them sick (GSC 2002a).



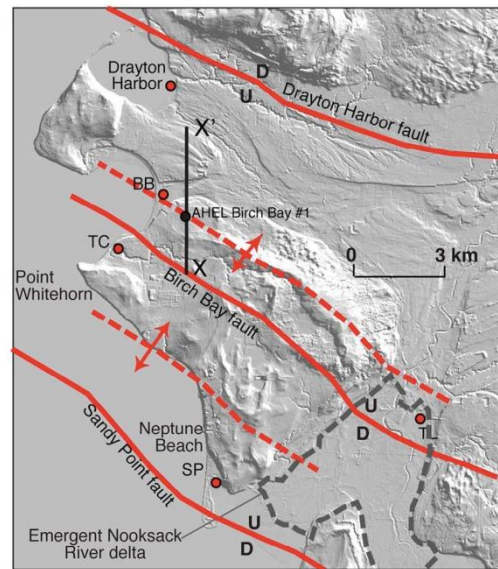
(a) Selected Earthquakes 1872-2002 (PNSN 2003)



(b) Major Fault Zones in the Puget Sound (Gower et al. 1985)



(c) Sumas and Vedder Mountain Faults (Easterbrook et al. 2000)



(d) Drayton Harbor, Birch Bay, and Sandy Point Faults (Kelsey et al. 2012)

Figure 5.12 Locations of Recorded Earthquakes and Faults in the Reservation Region

Table 5.7 Notable Regional Earthquakes¹

Year	Type	Epicenter Location Relative to the Reservation	Magnitude ² (Richter Scale)	Comment
2015	Crustal	40 miles SE	3.7	▪ Near Lake Cavanaugh
2013	Crustal	25 miles S	3.4	▪ Near La Connor
2012	Crustal	30 miles W	4.0	▪ Northwest of San Juan Island
2012	Crustal	25 miles W	3.0	▪ Northern San Juan Island
2012	Crustal	34 miles SE	3.6	▪ South of Mount Vernon
2011	Crustal	27 miles SW	3.6	▪ Northern San Juan Island
2010	Crustal	37 miles S	3.1	▪ West of Whidbey Island
2009	Crustal	39 miles S	4.0	▪ Whidbey Island
2009	Crustal	20 miles E	2.4	▪ Near Deming
2009	Crustal	7 miles N	2.6	▪ Near Ferndale
2008	Crustal	42 miles S	3.6	▪ Near Port Townsend
2007	Crustal	24 miles SW	3.0	▪ Near Friday Harbor
2007	Crustal	10 miles SE	3.0	▪ Five miles south of Bellingham ▪ Three miles deep
2005	Crustal	20 miles NE	4.1	▪ Four miles south of Kendall ▪ Less than one half mile deep ▪ No reported damage or injuries
2002	Crustal	31 miles SW	4.1	▪ South of San Juan Island
2001 (Nisqually Earthquake)	Intraplate	120 miles S	6.8	▪ Approximately 11 miles NE of Olympia ▪ Strong shaking for 40 seconds ▪ Over 700 injuries, 1 death ▪ \$2.0-3.5 billion in total damages ▪ \$128,471 in public damages on the Reservation
1996	Crustal	79 miles SE	5.4	▪ Near Duvall
1990	Crustal	20 miles E	5.0	▪ Near Deming
1976	Intraplate	33 miles W	5.1	▪ West of North Pender Island
1967	Crustal (?)	5-10 miles W	4.1	▪ Near the northeast shore of Orcas Island
1965	Intraplate	105 miles S	6.5	▪ Near SeaTac Airport ▪ 7 deaths ▪ Approximately \$12.5 million total damage ▪ Landslides, liquefaction, and other ground failures
1964	Crustal (?)	10 miles NE	5.0	▪ Between Ferndale and Lynden
1949	Intraplate	130 miles S	7.1	▪ Near Olympia ▪ Strong shaking for 20 seconds ▪ 8 deaths ▪ Approximately \$25 million total damage ▪ Probable trigger of landslide that caused 8 foot tsunami, other ground failures also reported
1946	Crustal	125 miles NW	7.3	▪ Central Vancouver Island ▪ 2 deaths ▪ Many chimneys toppled, buildings damaged ▪ Strong shaking on the Reservation
1920	Crustal (?)	22 miles SW	5.5	▪ Northwest corner of Shaw Island ▪ Slight damage in Bellingham, Anacortes, and Victoria, British Columbia
1909	Intraplate (?)	5-10 miles W	6.0	▪ Near the northeast shore of Orcas Island ▪ 19 miles deep ▪ Slight damage in Blaine, Bellingham, and Anacortes

Table 5.7 Notable Regional Earthquakes¹

Year	Type	Epicenter Location Relative to the Reservation	Magnitude ² (Richter Scale)	Comment
1896	Crustal (?)	20 miles S	6.0	▪ Near Decatur Island
1872	Crustal	60-120 miles E or SE	7.3	▪ Damage in Seattle and Victoria, British Columbia
1700	Megathrust	120 miles W	~9.0	▪ Tsunami destroyed village on Vancouver Island, caused damage in Japan ▪ Evidence of land subsidence
~900	Crustal	90 miles S	~7.0+	▪ Along Seattle Fault zone ▪ Massive landslides, tsunami deposits along Puget Sound, land subsidence

¹Noson et al. 1988, Chleborad and Schuster 1990, Atwater and Moore 1992, Engebretson 1996, Whatcom County 2002, Clackamas County 2002, GSC 2002a, GSC 2002b, Gambrell 2005, Millage 2007, PNSN 2010, PNSN 2015
²Magnitudes before 1969 are approximate (Engebretson 1996)

5.5.2.2. Intraplate Earthquakes

The most recent intraplate earthquake that affected the Reservation was the magnitude 6.8 Nisqually Earthquake of February 28, 2001. The epicenter of this earthquake was located 35 miles southwest of Seattle (or about 120 miles south of the Reservation) at a depth of approximately 30 miles underground. The Nisqually Earthquake caused one death, hundreds of mostly minor injuries, and estimated total damages of \$2.0-3.5 billion. President Bush granted federal disaster assistance on March 1, 2001 (FEMA 2001b). The Nisqually Earthquake was easily felt (light to moderate shaking) on the Reservation and caused damage to some buildings in the area, as well as subsidence of the Seapond Aquaculture Facility dike. The FEMA awards for damage to tribal facilities from the Nisqually Earthquake totaled \$128,471 (Bunton 2003); the cost to repair damages to LIBC buildings was \$54,607 and the cost to repair damages to the Seaponds Aquaculture Facility dike was \$73,864 following the Nisqually Earthquake. There were additional disaster assistance awards to individuals and possibly businesses on the Reservation.

Other intraplate earthquakes occurred on April 13, 1949 near Olympia (magnitude 7.1) and on April 29, 1965 between Seattle and Tacoma (magnitude 6.5). These intraplate earthquakes caused landslides, liquefaction, and/or other ground failures in the Puget Sound region and may have produced some damage in the Reservation area (Whatcom County 2002). The 1949 earthquake probably triggered the landslide that occurred three days later at the Tacoma Narrows and produced an eight foot high tsunami in Puget Sound. The tsunami reflected off of the undeveloped opposite shoreline and caused minor flood damage to homes adjacent to the landslide. The landslide itself destroyed the homes in its path (Noson et al. 1988, Walsh 2003). In addition, a large portion of a sandy spit jutting into Puget Sound north of Olympia disappeared during the earthquake (USGS 2001a).

5.5.2.3. Crustal Earthquakes

Large crustal earthquakes that may have impacted the Reservation include a magnitude 7.0 or greater earthquake along the Seattle Fault zone about 1,100 years ago. Evidence of this earthquake includes large landslides and tsunami deposits (Atwater and Moore 1992). Another large crustal earthquake that may have impacted the Reservation was a magnitude 7.3 North Cascades earthquake in 1872. During the 1872 earthquake, the epicenter of which was probably

located between Mt. Baker and Lake Chelan, shaking was reportedly felt from central British Columbia to central Oregon and east into the present day Alberta and Montana. Occurring today, this earthquake would probably cause strong shaking but only slight damage on the Reservation because the epicenter was some distance away (GSC 2002b).

The largest historic onshore earthquake recorded in southwestern British Columbia was a magnitude 7.3 event that occurred in 1946. The epicenter was in central Vancouver Island, just to the west of the communities of Courtenay and Campbell River. This earthquake caused considerable damage on Vancouver Island, and was felt as far away as Portland, Oregon, and Prince Rupert, British Columbia. The earthquake toppled 75 percent of the chimneys in the closest communities (Cumberland, Union Bay, and Courtenay) and did considerable damage in Comox, Port Alberni, and Powell River (on the eastern side of the Strait of Georgia). Two deaths resulted from this earthquake, one due to drowning when a small boat capsized in an earthquake-generated wave, and the other from a heart attack in Seattle (GSC 2002c). Occurring today, the shaking on the Lummi Reservation from this earthquake would be strong, or frightening to most people, but the potential damage would probably be slight (FEMA 2001a).

Many earthquakes have occurred near the Reservation over the past decade, but these events have not caused reportable damages on the Reservation. For instance, on November 24, 2005 a magnitude 4.1 crustal earthquake occurred approximately 20 miles northeast of the Reservation near the town of Kendall. The earthquake had an epicenter four miles south of Kendall at a depth of approximately one third of a mile. The earthquake lasted only a few seconds and no injuries or damages were reported. This earthquake may have occurred along the Kendall scarp, which was recently discovered through a Light Detection and Ranging (LIDAR) survey of the North Fork of the Nooksack River (Barnett et al. 2006). In March 2005, a swarm of earthquakes occurred off of the west coast of Vancouver Island. The series of nearly 4,000 magnitude 4.0 and under earthquakes occurred over 6 days along the Juan de Fuca ridge on the seafloor, and indicated the formation of new oceanic crust and the movement of the Juan de Fuca plate (Doughton 2005). These earthquakes did not cause any damage on land. Small crustal earthquakes continue to occur throughout the region, seven earthquakes between a magnitude of 3.0 and 4.0 were recorded in the region during the 2010-2015 period.

5.5.3. Earthquake Vulnerability Assessment

This section describes the earthquake vulnerability assessment by probability, liquefaction zones, and possible damages.

5.5.3.1. Earthquake Probabilities on the Reservation

The National Seismic Hazard Mapping Project of the United States Geological Survey (USGS) Earthquake Hazards Program indicates that an earthquake producing a peak ground acceleration (PGA) ranging from 23.5 to 24.7 on the Reservation has a 10 percent probability of exceedence over 50 years (or an average occurrence of once in 475 years, or approximately a 0.2 percent chance of occurring in any one year). An earthquake producing a PGA ranging from 45.5 to 47.3 has a 2 percent probability of exceedence over 50 years (or an average occurrence of once in 2,476 years, or approximately a 0.04 percent chance per year). For reference, these PGA values are approximately 50 percent less than PGA values for earthquakes in the Oakland and

the Los Angeles areas of California, the state with the greatest earthquake vulnerability in the continental United States, with the same recurrence interval (USGS 2003b).

The USGS data and the information in Table 5.5 indicate that, since the Modified Mercalli Intensity (MMI) categories represent a range of PGA values, the chance the Reservation will experience an earthquake that produces very strong shaking and that results in moderate potential damage (i.e., a PGA greater than 18) is somewhat greater than 10 percent over 50 years (or more frequent than once in 475 years). Likewise, there is greater than a 2 percent chance over 50 years (or more frequent than once in 2,476 years) that severe shaking and moderate to heavy potential damage will occur.

It is important to note that the PGA probabilities described here were calculated using all known potential earthquake sources and all magnitudes for each source that were believed possible in the vicinity of the location (USGS 2001b). An average probability was determined for each magnitude-location pair and the probabilities were added to provide the overall probability for a specific level of ground motion. The presence of unknown or underestimated earthquake sources could mean that the chance of a strong earthquake is greater.

The USGS analysis determined that the most likely source for earthquake damage on the Reservation is an earthquake with a moment magnitude of 5.0 to 7.0 within 16 miles of Bellingham (e.g., the 1909 earthquake just northeast of Orcas Island with a magnitude of 6.0 on the Richter scale). Similar earthquakes up to 62 miles from Bellingham and earthquakes of moment magnitudes from 8.0 to 9.0 that are 47 to 78 miles from Bellingham are also significant contributors to the overall PGA probability for the Reservation. In this USGS study, an earthquake with a moment magnitude of 7.0 to 7.5 within 31 to 47 miles of Bellingham contributed less than 0.1 percent to the overall PGA probability for the Reservation; the probability contribution of a magnitude 7.0 or greater earthquake within 47 miles of Bellingham was otherwise considered to be zero (USGS 2001b). This information suggests that the possibility of an MMI-IX earthquake with a PGA of between 65 and 124 that produces violent shaking and high potential damage on the Reservation is believed to be nearly negligible.

Recent geologic studies continue to refine our understanding of existing faults on and near the Reservation. In 2000, a study indicated that two long-recognized faults, the Sumas Fault and the Vedder Mountain Fault, are longer and more active than previously understood. These crustal faults extend from southwest from British Columbia and pass near or through the Reservation, respectively. In a 2012 study, researchers confirmed the presence of three additional faults in the vicinity of the Reservation, the Drayton Harbor, Birch Bay, and Sandy Point faults, which had been suspected but, until 2012, unmapped (Kelsey et al. 2012). The Sandy Point fault passes through the Sandy Point and Lummi peninsulas, while the Birch Bay and Drayton Harbor are found further north. The faults found throughout Whatcom County are responsible for past earthquakes in the region and their close proximity suggests that they may represent the largest potential source of earthquake hazards on the Reservation (Easterbrook et al. 2000, Federal Energy Regulatory Commission 2002). As such, they may be the most likely source for the earthquakes with a moment magnitude of 5.0 to 7.0 within 16 miles of Bellingham that, as described above, contribute most to the overall PGA probability for the Reservation.

5.5.3.2. Liquefaction on the Reservation

In evaluating potential liquefaction damages to structures on the Reservation, it is important to consider that impacts will vary with the local geologic conditions and the extent to which mitigation measures were taken during the construction or retrofitting of structures. Structures sited on shoreline fill, soft soils, or alluvial deposits, such as the Nooksack River floodplain, Sandy Point Peninsula, and Gooseberry Point shoreline, may experience damage that is one to two categories higher than the average potential damage on the Reservation (FEMA 2001a, Clackamas County 2002). Similarly, the glacial deposits forming the uplands on the Reservation will have a higher response to seismic shaking relative to areas of bedrock (Whatcom County 1995b).

In 2004, the Washington State Department of Natural Resources (DNR) Division of Geology and Earth Resources developed liquefaction susceptibility and National Earthquake Hazards Reduction Program (NEHRP) site class maps for each county in Washington State (Palmer et al. 2004). The liquefaction susceptibility map provides an estimate of the likelihood that soil will liquefy as a result of earthquake shaking. Liquefaction occurs when strong shaking causes a reduction or loss of soil strength and typically occurs in areas with saturated soils, such as low-lying coastal areas, lakeshores, and river valleys. The DNR maps show that the Sandy Point and Floodplain assessment areas of the Reservation have a moderate to high liquefaction susceptibility, the Lummi Peninsula has a combination of low and low to moderate susceptibility, and Portage Island and the Northwest Upland have low liquefaction susceptibility.

The DNR site class maps are based on the change in earthquake wave velocity from the underlying rock of the Earth's crust to the surface soil. Ground shaking at the surface is amplified when the earthquake waves are slowed as they travel to softer soil types. Generally, the greater the wave velocity difference, the greater the amplification of ground surface shaking. Areas mapped as Site Class B are those with a soft rock condition where shaking is neither amplified or reduced. Site Classes C, D, and E represent increasingly softer soil conditions and therefore increasing amplification of shaking. On the Reservation, the Floodplain assessment area is Site Class D to E, the Sandy Point Peninsula and Gooseberry Point are Site Class D, the Lummi Peninsula is a combination of Site Class C to D and D, and the Northwest Upland and Portage Island are Site Class C to D. Both the liquefaction susceptibility and site class maps have been incorporated into the earthquake vulnerabilities for the Reservation shown in Figure 5.13.

5.5.3.3. Possible Damages on the Reservation

The majority of the buildings on the Reservation were built over the past three decades, when seismic design requirements were well-established, and are unlikely to suffer significant damage during the most probable earthquakes. Of the buildings built before seismic design requirements were in place, most are single story. Thus, the probability of deaths or serious injuries resulting from the collapse of buildings is low, especially given the low probability of a severe earthquake causing heavy damage. Buildings with unreinforced, weight-bearing brick walls constructed with sand-lime mortar are most vulnerable and older multistory buildings may be moderately vulnerable, but the performance of wood frame structures should be excellent, based on experience in recent earthquakes (WEMD 2001). In the event of a strong or very strong earthquake, however, many structures and facilities would likely suffer damages, particularly

those vulnerable to amplification and liquefaction (i.e., those located within the Sandy Point, Floodplain, and Gooseberry Point assessment areas). Table 5.8 lists the estimated vulnerability for structures in the five developed assessment areas of the Reservation.

In addition to earthquake damages to buildings on the Reservation, public safety, public health, environmental, cultural, and economic impacts could also be damaging. For instance, electrical power poles and pipelines on the Reservation are vulnerable to amplification and, in some areas, liquefaction. Downed electrical lines could result in short- or long-term loss of power, which has implications for public health and safety and economic productivity. It should be noted that the Lummi Tribal Sewer and Water District sewer pump stations are equipped with backup diesel generators for use during electrical power outages to prevent sewer overflows. Pipelines that are gravity systems could be affected by changes in grade or by flotation caused by liquefaction. Water lines that fail and drain cannot be used to provide water for fire suppression, drinking, sanitation, and other uses. Road closures due to earthquake damages, particularly in Floodplain assessment area or to the bridges located off-Reservation that cross the Nooksack River, could generate the same problems for emergency services, vulnerable populations, and economic losses (direct and indirect) as were described for flood vulnerability (see Section 5.4.3). Cultural resources could be impacted due to ground disturbance; this may be most prevalent in the Floodplain assessment area. Furthermore, damages to any of the industries located near the Reservation, including the BP Cherry Point Refinery, the Phillips 66 Ferndale Refinery, and the Alcoa-Intalco aluminum smelter, which have the potential to result in oil or other hazardous materials spills, could result in substantial human health, environmental, and economic consequences.

5.5.4. Potential Earthquake Losses

The 2001 Nisqually Earthquake recently demonstrated the potential for earthquake damage in the Reservation region. According to a FEMA study, Washington ranks second in the nation (after California) among states susceptible to economic loss caused by earthquakes and has a predicted annualized economic loss of \$228 million due to earthquakes (WEMD 2004). Seattle is ranked 7th and Tacoma is 22nd on a list of cities with more than \$10 million in annualized earthquake losses. The 2008 Washington State Hazard Mitigation Plan found that Whatcom County is 1 of 24 counties in the state most vulnerable to future earthquakes (WEMD 2008). A HAZUS analysis determined that Whatcom County has an annualized earthquake loss of \$4,987,000 and an annualized earthquake loss ratio of 0.04 (WEMD 2004). These economic losses in the Reservation region will have direct and indirect effects on the residents and businesses of the Reservation. Developing an accurate dollar estimation of building losses on the Reservation due to an earthquake would require building information such as date of construction, type of building, seismic design at date of construction, and assessed values of buildings, as well as information on the earthquake hazard. Some of this information is not available for the Reservation and such a detailed study, even using the Hazards-U.S. (HAZUS) software developed by FEMA, is beyond the scope of this plan at this time. However, approximate losses estimated by HAZUS (1999 version) were provided by the Washington Emergency Management Division (WEMD) using default data from the 1990 Census (Quarles 2003).

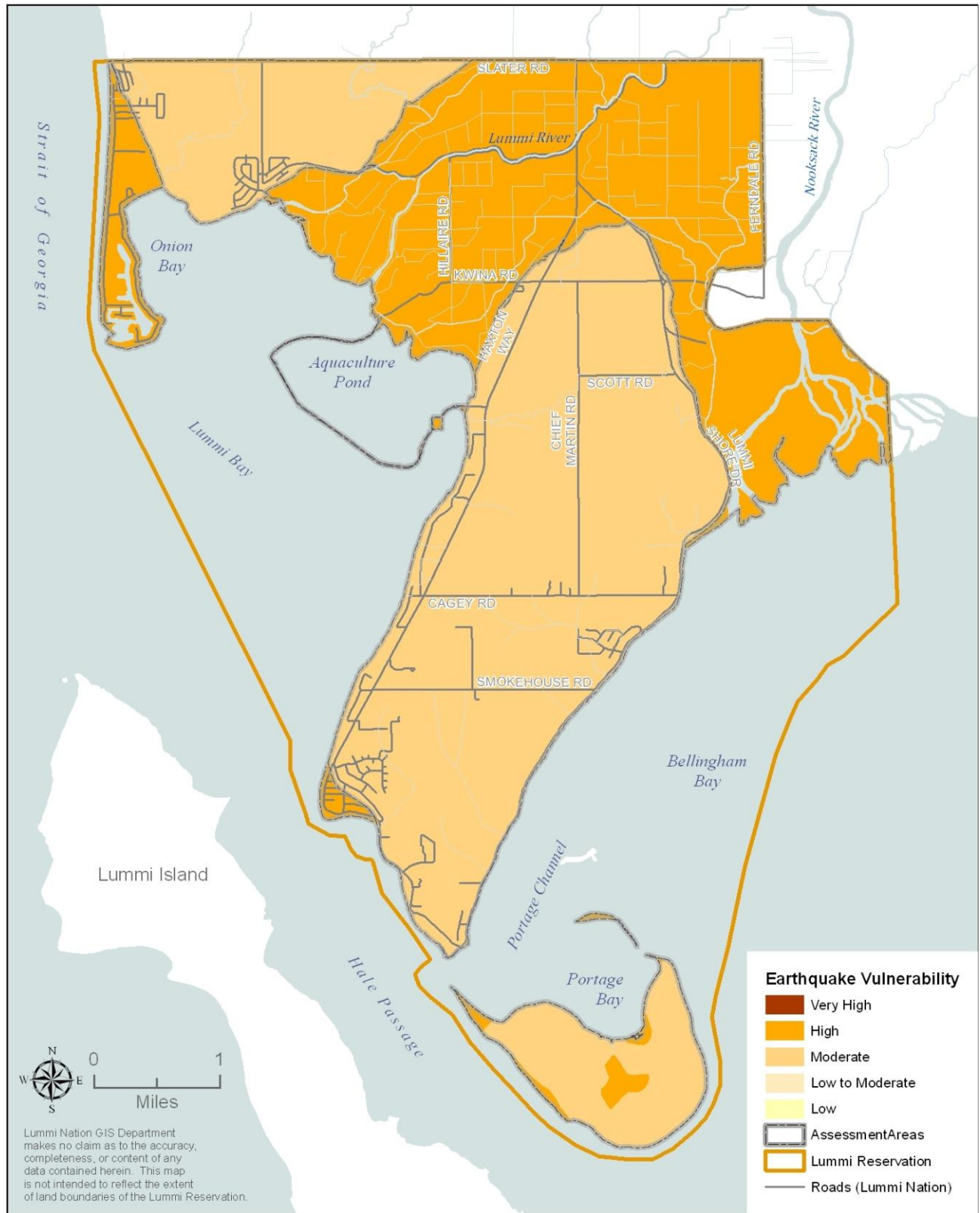


Figure 5.13 Estimated Earthquake Vulnerabilities in Reservation Areas

Table 5.8 Estimated Earthquake Vulnerability of Selected Structures

Assessment Area	Structure(s)	Year Built	Estimated Vulnerability ¹	Comment
All (except Portage Island)	Lummi Tribal Water District wells, reservoirs, and water lines	1964-Present	Moderate	<ul style="list-style-type: none"> Pipelines through areas of unconsolidated soils are more vulnerable
	Lummi Tribal Sewer District sewer lines and pump stations	1982-Present	Moderate	<ul style="list-style-type: none"> Collection lines, force mains, and pump stations through areas of unconsolidated soils are more vulnerable Disruptions to sewer collection and treatment system affects the entire Reservation community
	Roads	Variable	Moderate	<ul style="list-style-type: none"> Roads through areas of unconsolidated soils are more vulnerable
	Electric Lines	Variable	Moderate	<ul style="list-style-type: none"> Lines through areas of unconsolidated soils are more vulnerable
	Phone Lines	Variable	Low	<ul style="list-style-type: none"> Lines through areas of unconsolidated soils are more vulnerable
Lummi Peninsula	Lummi Tribal Administration Center	2013	Low	<ul style="list-style-type: none"> Enhanced shaking possible in terrace deposits, site class C-D Newer steel-frame structure
	LIBC East, Central, and West Campus Offices	1950s-Present	Moderate	<ul style="list-style-type: none"> Enhanced shaking possible in terrace deposits, site class C-D Some older wood-frame and cinder block construction, some older modular buildings, and some newer wood-frame structures
	Tribal Health Clinic	2000	Low	<ul style="list-style-type: none"> Enhanced shaking possible in terrace deposits, site class C-D Newer wood-frame structure
	Lummi Early Learning Programs	2000-Present	Low	<ul style="list-style-type: none"> Enhanced shaking possible in terrace deposits, site class C-D Newer wood-frame structures
	Gooseberry Point Wastewater Treatment Plant	1982	Moderate	<ul style="list-style-type: none"> Enhanced shaking possible in Bellingham Drift soils, site class D
	Kwina Road Wastewater Treatment Plant	2006	Low	<ul style="list-style-type: none"> Enhanced shaking possible in terrace deposits, site class C-D
	Northwest Indian College	1950s-Present	Moderate	<ul style="list-style-type: none"> Enhanced shaking possible in terrace deposits, site class C-D Some older wood-frame structures and block foundations, some older modular buildings, some newer wood-frame structures
	Lummi Nation School	2004	Low	<ul style="list-style-type: none"> Tilt up concrete exterior walls and timber space frame long span structures and glu-lam beams
	Wex'li'em (Community Building)	1995	Low	<ul style="list-style-type: none"> Large timber-frame structure
	Little Bear Creek Elders Home	2000	Low	<ul style="list-style-type: none"> Large wood-frame structure
	Gooseberry Point Fire Station	1963	Low	<ul style="list-style-type: none"> Enhanced shaking possible in Bellingham Drift soils, site class D

Table 5.8 Estimated Earthquake Vulnerability of Selected Structures

Assessment Area	Structure(s)	Year Built	Estimated Vulnerability ¹	Comment
	Residences	Pre-1950-Present	Low to Moderate	<ul style="list-style-type: none"> • Variable age and seismic design of structures • Many homes built before 1976
Floodplain	Silver Reef Hotel, Casino, & Spa	2001+	Low	<ul style="list-style-type: none"> • Enhanced seismic design, including foundation columns extending 20 feet below the ground • Moderate to high liquefaction risk, site class D-E
	Lummi Mini-Mart	1998	Moderate	<ul style="list-style-type: none"> • Enhanced shaking possible, site class D-E • Moderate to high liquefaction risk • Fuel lines possible source of leaks, automatic shut-off valve • Fuel tanks are double wall fiberglass with approved leak detectors and monitors, meet EPA regulations • Merchandise on shelves exposed
	Shellfish Hatchery	1972	Moderate	<ul style="list-style-type: none"> • Older structures may not meet current seismic standards • Enhanced shaking possible in unconsolidated alluvial deposits, site class D-E • Moderate to high liquefaction risk
	Lummi Bay Salmon Hatchery	1972	Moderate to High	<ul style="list-style-type: none"> • Enhanced shaking possible in unconsolidated alluvial deposits, site class D-E • Moderate to high liquefaction risk
	Residences	Pre-1950-Present	Moderate to High	<ul style="list-style-type: none"> • Enhanced shaking possible, site class D-E • Moderate to high liquefaction risk • Mostly agricultural land use; relatively few homes
Northwest Upland	Sandy Point Heights Fire Station	1980s	Low	<ul style="list-style-type: none"> • Enhanced shaking possible in Bellingham Drift soils, site class C-D
	Residences	Pre-1950-Present	Low to Moderate	<ul style="list-style-type: none"> • Variable age and seismic design of structures • Approximately half of homes before 1976 • Enhanced shaking possible in Bellingham Drift soils, site class C-D
Portage Island	No Structures	n/a	n/a	<ul style="list-style-type: none"> • Currently unoccupied and undeveloped
Sandy Point Peninsula	Sandy Point Fire Station	1998	Moderate	<ul style="list-style-type: none"> • Enhanced shaking possible in alluvial deposits, site class D • Moderate to high liquefaction risk
	Sandy Point Salmon Hatchery	1980s	Moderate to High	<ul style="list-style-type: none"> • Enhanced shaking possible in alluvial deposits, site class D • Moderate to high liquefaction zone

Table 5.8 Estimated Earthquake Vulnerability of Selected Structures

Assessment Area	Structure(s)	Year Built	Estimated Vulnerability ¹	Comment
	Sandy Point Wastewater Treatment Plant	1982	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking possible in alluvial deposits, site class D Moderate to high liquefaction zone Structure upgrades underway in 2015
	Residences	1962-Present	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking possible in alluvial deposits, site class D Moderate to high liquefaction risk Many homes before 1976
Gooseberry Point	LIBC Fish Buying Station and Pier	1980s	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking possible, site class D Low to moderate liquefaction risk
	LCC Dock, Dock Office, Repair Shop, Boat Storage	1950s+	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking possible, site class D Low to moderate liquefaction risk Older structures, may not meet current seismic standards
	Fisherman's Cove Mini-Mart	1950s+	Moderate to High	<ul style="list-style-type: none"> Temporary modular building replaced original structure in 1990s Enhanced shaking possible, site class D Low to moderate liquefaction risk Fuel lines possible source of leaks, automatic shut-off valve Fuel tanks are double wall fiberglass with approved leak detectors and monitors, meet EPA regulations Older building, may not meet current seismic standards Merchandise on shelves exposed
	Residences	Pre-1950-Present	Moderate to High	<ul style="list-style-type: none"> Enhanced shaking possible, site class D Low to moderate liquefaction risk Most homes before 1976

¹Estimated based on underlying soil, site class, liquefaction susceptibility, year built/seismic design, and type of construction

According to the analysis preformed by WEMD, the estimated annualized losses on the Reservation due to structural damage (\$9,000), nonstructural damage (\$41,000), and contents damage (\$15,000) totaled \$65,000 (2003 dollars). These estimated losses to structures and contents represented a loss ratio of 0.04 percent (evidently based on an outdated total value for structures and contents of \$162.5 million). Based on the current figures listed in Table 5.1, the total structure and contents value of all private residences and public facilities on the Reservation is now nearly \$660 million. Annualized losses based on this figure and a loss ratio of 0.04 percent indicates a total annualized loss of approximately \$264,000 for structures and their contents. However, because the newer structures contributing to this larger estimate of structure values are less vulnerable than older structures, the total annualized loss is likely lower than \$264,000. In the HAZUS analysis, residential structures represented 92 percent of structure value on the Reservation, thus residences accounted for the majority of damages. Unreinforced masonry structures were estimated to represent 0.6 percent of the structure inventory. The estimated annualized income losses (due to relocation, capital-related, wage, and rental income losses) on the Reservation totaled \$9,000. This estimate is too low, as accurate information about the businesses and places of employment on the Reservation was not available for the HAZUS analysis and because both revenue generated on the Reservation and total payroll values have increased with the establishment of the Silver Reef Hotel, Casino & Spa. Even with the annualized total damages of only \$74,000 assumed in the HAZUS analysis, over 50 years the probable damages would total \$3.7 million.

For a specific, moment magnitude 7.1 earthquake on the South Whidbey Island fault with a PGA on the Reservation of 8.4, the HAZUS program estimated the following probabilities for damage to structures:

- None: 89 percent
- Slight: 8 percent
- Moderate: 3 percent
- Extensive: <1 percent
- Complete: 0 percent

As described in Section 5.5.1, an earthquake generating a PGA on the Reservation greater than 8.4 will occur someday, but its probability is much lower than this modeled event. An updated HAZUS-MH (Multi-Hazard) version may show similar slight damages on the Reservation since structures built since 1990 should be resistant to earthquake damage. However, if the estimated earthquake hazard has increased, damage may be proportionally larger.

5.6. Severe Winter Storms

Winter storm hazards include heavy snows, ice storms, and extreme cold. In this section, past winter storm events, winter storm vulnerability, and potential winter storm losses on the Reservation are described.

5.6.1. Profiles of Winter Storm Hazards

A blizzard is defined as sustained wind or frequent gusts to 35 mph or greater and considerable falling and/or blowing snow that frequently reduces visibility to less than a quarter-mile. The Washington State Hazard Mitigation Plan identifies Whatcom County as 1 of 18 counties in the state most vulnerable to winter storms (WEMD 2008). Nearly every winter, outflows of very cold arctic air move south down the Fraser River valley in Canada and push into the Whatcom County area, often moving directly onto the Reservation. The cold air is usually accompanied by strong northeast winds that can topple trees and disrupt power. The strong winds also can result in a dangerous wind chill effect. When the cold arctic air flowing from the north meets warm moist air from the south, snow can result, sometimes with significant accumulations. Like most other natural hazards, heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulation of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days. The cost of snow removal, repairing damages, and loss of business can have large economic impacts. Similarly, heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. In addition, ice jams may form on rivers and in storm sewer systems and lead to flooding. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening (NOAA 1991).

5.6.2. Effects of Past Winter Storm Events

Table 5.9 lists the major recorded winter storms that have affected the Reservation. The winters of 1996/1997 and 2008/2009 had particularly noteworthy storm events and are discussed here in further detail. During the 1996/1997 winter storms, high snowfall and cold temperatures resulted in significant snow accumulations. The accumulations, aggravated by rain, drifting snow, and ice in roof drains, caused excessive weight and the collapse of structures. Roughly 70 residents on the Reservation received disaster assistance from FEMA to fix damaged roofs; the LIBC also received funding to repair roofs of tribal buildings (Folsom 2003). High winds and ice contributed to the repeated and extended power outages that involved over 500,000 power customers during December 1996 through February 1997 (WEMD 2001). The 2008/2009 winter storms brought snow and strong winds. The Governor declared a State of Emergency for Washington State on December 24, 2008 and renewed the declaration on January 2, 2009. During this winter storm, nighttime temperatures dropped into the teens. Snow closed roads and the subsequent rains and flooding caused road damages. Coastal flooding resulted from a combination of southerly winds and high tides. The LIBC offices closed for three days, the LIBC released staff early for another three days, and the Lummi Nation School closed after the road conditions worsened and a tree fell on a school bus.

5.6.3. Winter Storm Vulnerability Assessment

Compared to the size of the Reservation, winter storms are relatively large-scale events. As a result, all six assessment areas of the Reservation are exposed to severe winter storms to a similar degree; however, there are some differences that exist in the vulnerabilities of the six

areas to winter storms. One such difference is that the relatively unforested Sandy Point Peninsula, Gooseberry Point, and Floodplain assessment areas are exposed to somewhat greater wind speeds and wind chill effects. On the other hand, the forested areas of the Reservation face the hazard of branches that may break and fall under the weight of snow and ice. Cultural resources that are forest-based or located in forested areas could be destroyed by the effects of high winds in a winter storm. Additionally, there are numerous slopes in the Lummi Peninsula and Northwest Upland areas that can be difficult to drive if the roads have not been plowed and sanded. One factor that increases the relative vulnerability of the Floodplain assessment area is possible riverine flooding caused by an ice dam forming in the Nooksack River. Finally, the Floodplain area and the north or east facing areas of the Reservation (including portions of the Northwest Upland, Portage Island, and Lummi Peninsula) are more exposed to the cold northeast winds from the Fraser Valley. Based on this greater exposure, these areas were estimated to have a high vulnerability to winter storms; the remainder of the Reservation is estimated to have a moderate vulnerability to winter storms. The estimated vulnerabilities to winter storms of the six assessment areas on the Reservation are shown in Figure 5.14.

The overall vulnerability of the Reservation to winter storms is moderate to high. These events present a significant hazard to public health and safety and a substantial disruption of economic activity, but a limited and infrequent hazard to structures. The generally short duration of winter storm effects also limits the vulnerability of the Reservation. The probability of occurrence is high since winter storms with smaller effects occur approximately every other year, while storms with larger effects occur less often. It is also important to note that because snow and freezing temperatures are irregular events on the Reservation, severe winter storms can catch residents off-guard and ill prepared, a factor which may make the Reservation population more vulnerable compared to population in colder regions where residents are accustomed to traveling in snow and ice conditions and are more likely to winterize their homes.

5.6.4. Potential Winter Storm Losses

It is difficult to estimate the cost of potential storm damages to structures on the Reservation. Damage to roofs from heavy snow accumulation depends on the age of the structure, the quality of construction, and the weight of the snow. Frozen water pipes will also result in a certain amount of damage. Storm water drains that become blocked by ice could lead to damages from local flooding. Any number of these factors could be combined to produce the total structural damages that may result from a winter storm. Infrastructure may be similarly impacted. For instance, utility lines could be broken by heavy accumulations of ice, causing power outages or loss of phone lines. These outages typically affect only a small geographic area, but in relatively rural areas like the Reservation, outages may be long in duration. Extended outages may require shelters to be opened, particularly in very cold weather. In the past, power outages have affected the wastewater collection system operated by the Lummi Tribal Sewer and Water District (LTSWD). For this reason, the LTSWD sewer pump stations are now equipped with backup diesel generators for use during electrical power outages to prevent sewer overflows.

The economic losses caused by a winter storm may frequently be greater than structural damages. Employees may not be able to get to work for several days, customers will stay at home, offices and businesses may not open, and damages will result in the cost of repairs and the cost of lost business while repairs occur. The Lummi tribal offices and schools are commonly

closed after a winter storm because of icy roads and the associated unsafe driving conditions. Depending on the size, duration, and timing of a winter storm, economic costs could be substantial. Overall, winter storms may occasionally result in significant human, economic, and property losses on the Reservation.

Table 5.9 Recorded Major Winter Storm Events in the Reservation Region¹

Date	Storm Type	Description
January 14-19, 2012	Snowstorm	Snowstorm with strong winds; LIBC offices closed and emergency procedures to provide medical care to Tribal Health Clinic patients in need of medical services were executed
December 8-18, 2010	Snowstorm, wind, heavy precipitation, flood, landslide, avalanche	Governor declared State of Emergency for 17 counties, including Whatcom County, for December 8-18, 2010; snow; high winds; heavy precipitation; minor flooding along the Nooksack River; landslides; avalanches; power outages
March 10, 2009	Snowstorm	Snow and strong winds
December 2008 to January 2009	Windstorm, coastal flooding, snow, ice, landslide, avalanche	Governor declared State of Emergency for Washington State on December 24, 2008, renewed on January 2, 2009; windstorm; coastal flooding from combination of southerly wind and high tides; snow and ice on roads; snow and heavy rains resulted in road closure and damage, local flooding, landslides, and avalanches; extreme nighttime cold temperatures; LIBC office and school closures
January 29-31, 2008	Snow and hail	Snow and hail; schools closed, delayed opening of LIBC offices
January 10, 2007	Snowstorm and wind	Snow accumulations of up to 10 inches; temperatures in the 20's; winds from 20-40 mph with gusts up to 65 mph; the LIBC and Lummi Nation School were closed for 2.5 days
November 27, 2006	Snowstorm	Snow accumulations of 6-12 inches in Whatcom County; temperatures in the mid 20's to lower 30's, with a record low temperature of 12°F recorded at the Bellingham International Airport on November 28, 2006; the LIBC and the Lummi Nation School were closed for 5 days; over \$575,000 was spent at the local, county, and state level for Whatcom County damages
December 26, 1996	Winter storm, wind, flooding, landslide, avalanche	Storm fronts pushed across Washington, causing structures to collapse under the heavy weight of snow, road closures, power outages, landslides, and 20 weather-related deaths; the Governor declared emergencies for 37 counties, including Whatcom County; Federal Disaster Number 1159
November 19, 1996	Ice storm	Approximately 50,000 customers in the Puget Sound area were without power; four weather-related deaths; \$22 million in damages; Federal Disaster Number 1152
1990	Winter storm	Two arctic storms that included snow accumulation, high winds, thaw and refreeze, and flooding on the Reservation.
January 1950	Snowstorm and wind	Snow accumulation of 21 inches in Seattle; winds from 25-40 mph; 13 weather-related deaths in the Puget Sound region.
February 1, 1916	Snowstorm and wind	Snow accumulation of 21 inches in Seattle within 24 hours (24-48 inches in other parts of western Washington)

¹WEMD 2001, Whatcom County 2002, Bellingham Herald, NOAA

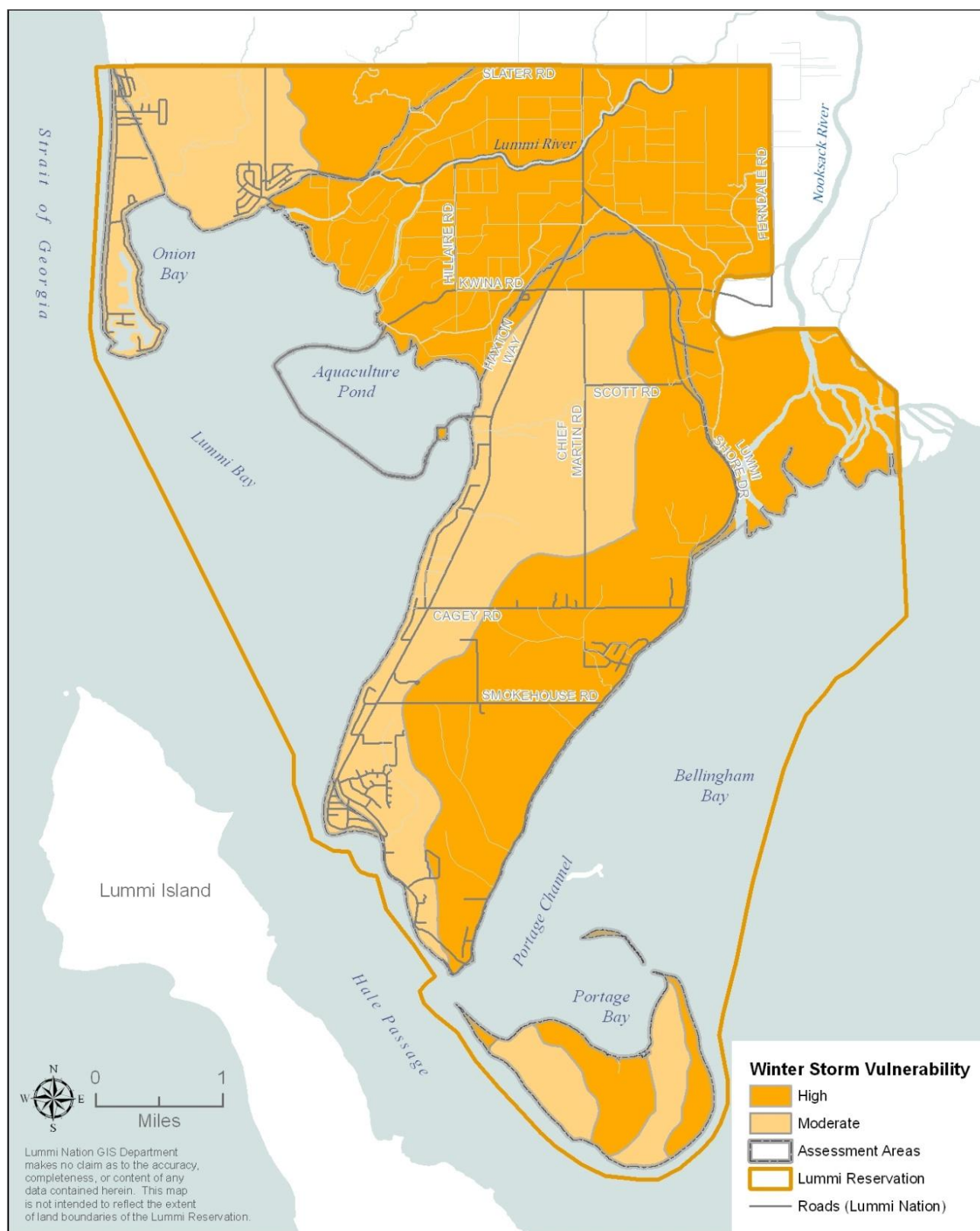


Figure 5.14 Estimated Winter Storm Vulnerabilities in Reservation Areas

5.7. Windstorms

Windstorms are a predictable hazard on the Reservation in the fall, winter, and early spring season. In this section, past windstorm events, windstorm vulnerability, and potential windstorm losses on the Reservation are described.

5.7.1. Profiles of Windstorm Hazards

Similar to severe winter storms, windstorms can threaten lives and property, disrupt vital electric power and telephone systems, and cause tremendous damage to forests. Windstorms on the Reservation can occur at any time of the year, but are most common from October through March. When winds are from the north or south, channeling or funneling of strong winds by Vancouver Island and the San Juan islands can increase wind speeds in the vicinity of the Reservation (Whatcom County 2002).

5.7.2. Effects of Past Windstorm Events

The Columbus Day Storm of 1962 was the strongest, most widespread, non-tropical windstorm to strike the continental United States in recorded history and affected an area from British Columbia, Canada to northern California. There were seven storm-related deaths in Washington State; throughout the region affected by the storm, nearly 50 lives were lost. Approximately 1 million homes lost power and more than 50,000 homes were damaged. Total property damage in the region was estimated at \$235 million (1962 dollars). The storm blew down approximately 15 billion board feet of timber worth an estimated \$750 million (1962 dollars), which is more than three times the timber blown down by the May 1980 eruption of Mount St. Helens and enough wood to replace every home in the state (Hill et al. 1999). Before the power was lost at recording stations, the highest recorded wind speeds during the Columbus Day storm were (Hill et al. 1999):

- Naselle, Washington: gust to 160 mph
- Portland, Oregon: gust of 119 mph
- Renton, Washington: gust of 100 mph
- Tacoma, Washington: gust of 88 mph
- Bellingham, Washington: gust of 98 mph
- Vancouver, British Columbia: gust of 92 mph

The local effects of the Columbus Day Storm were (Whatcom County 2002):

- Bellingham Airport reported 75 mph winds and gusts to 98 mph;
- Power wires flashed;
- Some windows exploded from changes in pressure;
- Some roofs ripped away;
- Sank the Whatcom County ferry (Chief Kwina) serving Lummi Island;
- Significant damages in rural areas throughout the county, including collapsed barns, sheds, and silos, livestock fatalities (i.e., cattle), downed trees and debris;

- The building occupied by Louis Auto Glass in Bellingham collapsed;
- The Sumas Bus Garage was destroyed;
- Damages were also reported at Western Washington University, City of Bellingham parks, and Lowell Elementary School in Bellingham and the Pioneer Rest Home in Ferndale.

Another large windstorm occurred on the morning of January 20, 1993 (called the Inauguration Day Storm), when a powerful low pressure system swept through western Washington and caused substantial damages, numerous injuries, and five deaths. Winds averaged 50 mph with gusts in the Puget Sound area to 60-70 mph. A gust at Cape Disappointment on the Washington Coast reached 98 mph. Throughout the Puget Sound region, 52 single-family homes, mobile homes, and apartment units were destroyed and 249 incurred major damage, many from falling trees and limbs. More than 580 businesses were damaged. Power outages affected 965,000 customers. Total damage in western Washington was estimated at \$130 million (WEMD 2001, Hill et al. 1999).

Summaries of major recorded windstorm events in the region are provided in Table 5.10.

5.7.3. Windstorm Vulnerability Assessment

Windstorms with sustained winds of 50 mph are powerful enough to cause significant damage and occur frequently in the Puget Sound region (WEMD 2001). In a large windstorm, the six assessment areas of the Reservation are exposed to comparable wind speeds, but have different levels of vulnerability because of the different hazards that exist within the assessment areas. Many of the buildings in the Lummi Peninsula and Northwest Upland areas are located in close proximity to trees that could be blown onto the buildings, an obvious hazard to personal safety and the integrity of the structure. Roads in these two assessment areas are also more likely to be blocked by fallen trees. Areas of denser development, such as Gooseberry Point, Sandy Point Heights, and the Sandy Point Peninsula, may face a greater hazard from fallen power lines relative to less developed areas. Direct wind damages to structures (e.g., damaged roof) should be similar across all six assessment areas, with total damages proportional to the number of structures. Similarly, cultural resources that are forest-based or are located in forested areas could be destroyed by the effects of high winds in a windstorm. Wind-driven waves present a coastal flooding hazard in shoreline areas, especially along the Sandy Point Peninsula and to a lesser degree at Gooseberry Point, Hermosa Beach, West Beach, and Portage Island (see Section 5.4 – Floods for details). High winds and wind-driven waves pose a hazard to the docks (e.g. Whatcom County ferry terminal, LCC dock) on the shoreline and the boats anchored in the Sandy Point Marina. These waves also generate much of the coastal erosion described in Section 5.8 – Coastal Erosion.

The estimated vulnerability of the six assessment areas on the Reservation is shown in Figure 5.15. Forested areas and coastal flood zones were estimated to have high wind vulnerability and non-forested areas were estimated to have moderate vulnerability to windstorms.

5.7.4. Potential Windstorm Losses

The potential losses to structures in the five developed assessment areas (i.e., all assessment areas except Portage Island) from a major wind event are summarized in Table 5.11. The

damages due to downed trees or direct wind effects for this hypothetical event are defined as 50 percent destruction of 5 percent of buildings (vulnerable buildings adjacent to trees) and destruction of roofs on an additional 5 percent of buildings (requiring roof replacement). Average estimated costs for replacement of the damaged structures were used to calculate total figures. Replacement costs for possible damage to boats in the Sandy Point Marina were not included. The costs of other losses, such as downed utility lines, loss of power, economic and governmental disruption, electrocution, and danger of fire, are difficult to accurately quantify and are not included in the estimated potential losses.

It is important to note that the majority of the coastal flooding that occurs along the Reservation shorelines is caused by wind-generated waves. That is, the damage from coastal flooding is largely due to windstorms in combination with high tides. As described in Section 5.4.1.3, windstorms from certain directions, when combined with high tide conditions, can result in coastal flooding along exposed shoreline areas. The aspect of each shoreline area, as well as the timing of the windstorm, determines whether an area is vulnerable to flooding during a specific windstorm. Consequently, the estimated potential losses due to coastal flooding listed in Table 5.3 can also be attributed to windstorms, and are therefore also listed in Table 5.11. Although these coastal flooding losses will depend on wind direction and tidal timing, the potential losses due to downed trees or direct wind effects are not dependent on wind direction or time of day, and therefore could occur during any strong windstorm (although downed trees are more likely during the beginning or end of the wet season when saturated soils are softer and trees either still have leaves or “leaf-out” has already occurred during the spring).

Table 5.10 Recorded Windstorm Events in the Reservation Region¹

Date	Description
December 11, 2014	Strong winds with gusts to 56 mph; 105,000 customers lose power in Puget Sound Energy's service area, including power outages across Whatcom County; downed trees; damaged homes in Bellingham area
December 9, 2014	Strong winds with gusts to 75 mph; power outages across Whatcom County; 600-foot Horizon Fairbanks container ship broke loose from mooring at Bellingham Shipping Terminal when the bow lines snapped due to high winds, no injuries or damages reported; downed trees; one flight at Bellingham International Airport cancelled
January 11, 2014	Winds from 35-45 mph with gusts to 60 mph; 40,000 customers lose power in Puget Sound Energy's service area, including power outages across Whatcom County
March 2, 2011	Power outages; downed trees; damaged homes in Bellingham area
November 18, 2009	Power outages; downed trees; damaged roads; Lummi Island ferry terminal damaged
November 12, 2009	Power outages; downed trees
October 18, 2009	Power outages; downed trees; one death on Lake Washington
May 5, 2009	Winds from 50-55 mph (predicted)
December 11, 2006	Gusts up to 41 mph; downed trees; power outages throughout Whatcom County; flights cancelled at Bellingham International Airport
November 15, 2006	SE winds from 30-45 mph with gusts up to 82 mph; 135,000 customers lost power statewide; power outage at Little Bear Creek (residents were temporarily relocated to the Silver Reef Hotel, Casino & Spa); one trailer on the Reservation was destroyed by a fallen tree
February 4, 2006	40 mph winds with gusts to 69 mph; flooding at Sandy Point and Gooseberry Point; Whatcom County announces emergency declaration
December 2001	Similar conditions to the December 2000 storm, but less severe; damage along the Sandy Point Peninsula
December 2000	Severe damage (approximately \$750,000) to beachfront homes along the Sandy Point Peninsula from waves/flooding generated by a combination of gale force northwest winds, extreme high tides, storm surge, and low pressure
October 27, 1999	Strong Pacific frontal system across western Washington; power and phone outages throughout the region; marine storm and coastal flood warnings issued for the coast; one death
March 3, 1999	Sustained winds of 40 mph with gusts to 129 mph; U.S. Coast Guard recommended that all marine vessels report to safe moorage
November 19, 1998	Winds of 80 mph; downed trees; power outages to 15,000 customers
October 29, 1997	SE winds of 58-81 mph; 5-6 foot seas; the commercial fishing vessel Miss Lindsay capsized during the night and four fishermen drowned in Hale Passage/Bellingham Bay; Miss Lindsay was discovered capsized on October 30 in Bellingham Bay approximately 0.1 nautical mile SE of Portage Island
December 1995	Storms across California, Oregon and Washington generate winds of 100 mph; Federal Disaster Number 1079
December 4, 1993	Sustained winds of 40-50 mph combined with a high tide to produce large breaking waves; damage to bulkheads and homes along the Sandy Point Peninsula

Table 5.10 Recorded Windstorm Events in the Reservation Region¹

Date	Description
January 20, 1993	Inauguration Day Storm; substantial damage to homes, businesses, and public utilities; power outages from Longview to Bellingham; Washington State Emergency Operation Center activated to coordinate resources; U.S. National Guard provided generator power; American Red Cross provided shelter to 600 people and 3,200 meals; Federal Disaster Number 981
September 1986	High winds and five-foot waves at Gooseberry Point; one commercial fishing boat is swamped and sinks at the LCC dock; the Lummi Island Ferry is closed, leaving 18 school children that resided on Lummi Island without a way home
December 1982	Flooding and high winds throughout Whatcom County; 122 people evacuated; 129 homes and 113 businesses were damaged; \$1.7 million in Stafford Act assistance for damages to public facilities; \$1 million in U.S. Small Business Administration loans to home and business owners for damages; Federal Disaster Number 676
February 25, 1979	Sustained winds from 25-30 mph; power outages affecting 4,000 customers in Whatcom County; Hood Canal Bridge near Port Gamble destroyed
February 13, 1979	Winds to 70 mph; power outages on Lummi Island, along Chuckanut Drive, along Highway 9 from Wickersham to Highway 542, and from Marine Drive north to Lynden
March 30, 1975	NW winds caused flood damage along the Reservation and Whatcom County shorelines; greatest damage occurred along the Sandy Point Peninsula
October 12, 1962	Columbus Day Storm, considered the greatest windstorm to hit the Pacific Northwest in recorded history; Federal Disaster Number 137
November 1958	High winds in across western Washington
November 7, 1940	Tacoma Narrows Bridge collapsed due to induced vibrations from 40 mph winds

¹WEMD 2001, Whatcom County 2002, FEMA 2003d, Millage 2006, Taylor 2006, Bellingham Herald

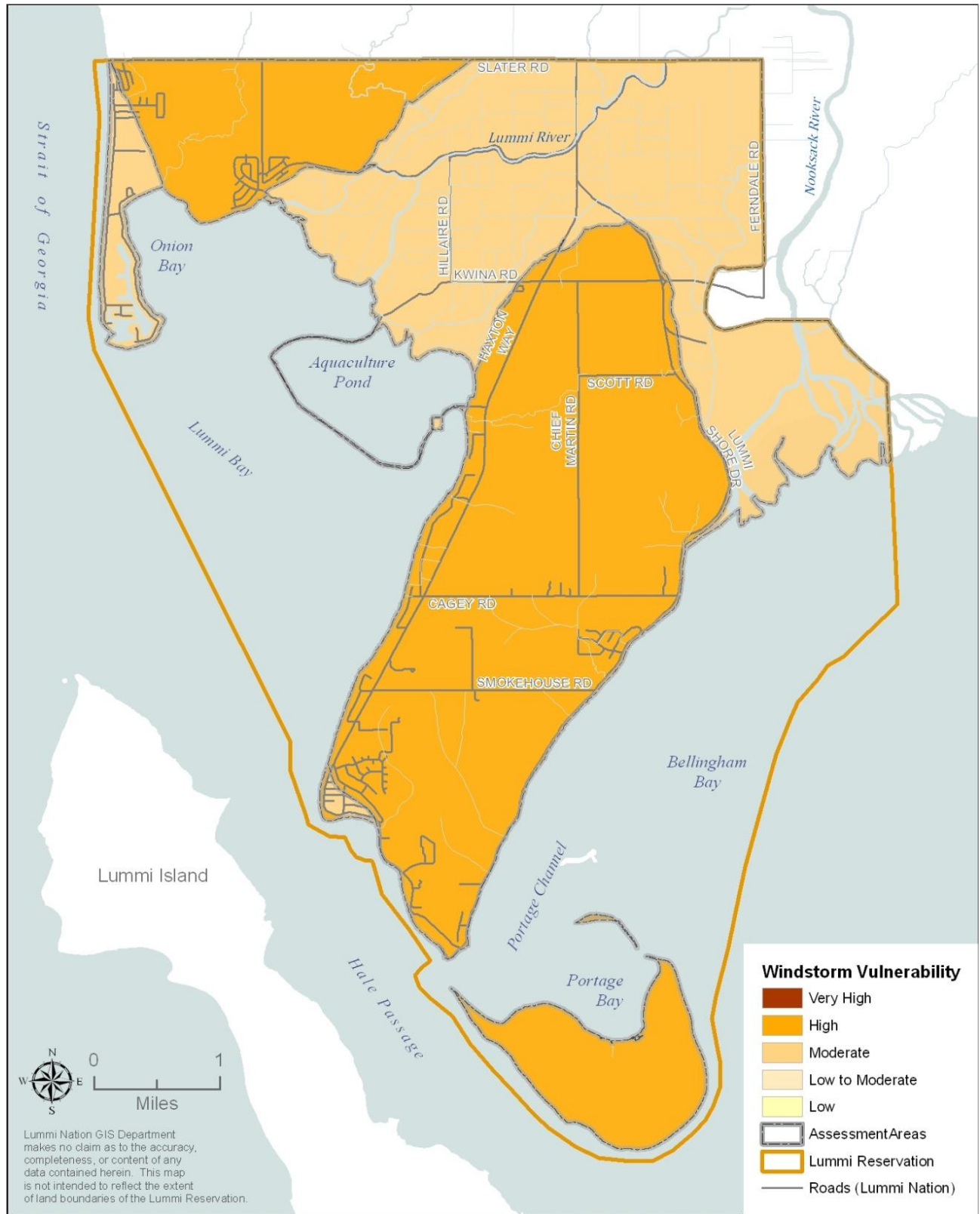


Figure 5.15 Estimated Windstorm Vulnerabilities in Reservation Areas

Table 5.11 Vulnerability and Potential Losses of Structures to Windstorms

Assessment Area	Estimated Vulnerability	Direct Wind or Tree Blowdown Damage			Coastal Flood Damage			Location/Comment
		Number of Structures	Structure Losses ¹	Roof Losses ²	Number of Structures	Structure Losses ³	Contents Losses ⁴	
Lummi Peninsula	High	1,271	\$7,203,692	\$158,875	22	\$1,104,626	\$452,314	<ul style="list-style-type: none"> Mostly forested, but areas surrounding public facilities are typically kept clear Coastal flooding in Robertson Road and Hermosa Beach areas
Floodplain	High	-	-	-	15	\$4,211,425	\$728,793	<ul style="list-style-type: none"> Coastal flooding includes Shellfish Hatchery and Lummi Bay Salmon Hatchery
	Moderate	61	\$0	\$7,625	-	-	-	<ul style="list-style-type: none"> Mostly unforested
Northwest Upland	High	423	\$769,108	\$52,875	1	\$43,456	\$21,728	<ul style="list-style-type: none"> Mostly forested
Portage Island	High	0	n/a	n/a	0	n/a	n/a	<ul style="list-style-type: none"> Mostly forested No structures
Sandy Point Peninsula	High	-	-	-	401	\$29,561,137	\$14,580,568	<ul style="list-style-type: none"> Western shoreline and south cape most vulnerable to coastal flooding Southern and eastern shorelines and interior of peninsula also vulnerable to coastal flooding
	Moderate	500	\$0	\$62,500	-	-	-	<ul style="list-style-type: none"> Mostly unforested
Gooseberry Point	High	-	-	-	131	\$11,731,332	\$2,050,493	<ul style="list-style-type: none"> LIBC Fish Buying Station and Pier, LCC Dock and Dock Office, Whatcom County Ferry Terminal most vulnerable to coastal flooding The remainder of Gooseberry Point also vulnerable to coastal flooding
	Moderate	131	\$0	\$16,375				<ul style="list-style-type: none"> Mostly unforested
Total		2,386	\$7,972,800	\$298,250	570	\$46,651,976	\$17,833,896	<ul style="list-style-type: none"> Total Windstorm Losses: \$64,485,872

¹Potential structure losses due to tree blowdown are estimated as 50 percent of total structure value for 5 percent of structures in high vulnerability areas

²Potential roof losses due to direct wind damage are estimated as the replacement cost of the roof (\$2,500) for 5 percent of structures in all vulnerability areas

³Potential structure losses estimated as 50 percent of total structure value

⁴Potential contents losses estimated as 50 percent of the total contents value

5.8. Coastal Erosion

Coastal erosion is a chronic hazard along some of the Reservation shorelines. In this section, past coastal erosion events, coastal erosion vulnerability, and potential coastal erosion losses on the Reservation are described.

5.8.1. Profiles of Coastal Erosion Hazards

Erosion is the general process or group of processes whereby earth materials are loosened, dissolved, or worn away and simultaneously moved from one place to another (Bates and Jackson 1980). The processes involved in coastal erosion on the Reservation may be wave action, storm surge, elevated El Niño sea level, accelerated sea level rise due to anthropogenic climate change, nearshore currents, tidal effects, and even subsidence due to Cascadia Subduction Zone earthquakes or other geologic processes. Physical factors that affect erosion rates include sediment sources; changes in relative sea level; sediment size, density, and shape; sand sharing of beaches, dunes, and offshore bars; effects of waves, currents, tides, and wind; offshore bathymetry; and shore defense works. Human influences can include alteration of the beach, dunes, or bluffs; dredging; construction of groins and jetties; hardening shorelines with seawalls or revetments; and beach nourishment. Coastal erosion can also lead to collateral damage such as flooding, bluff recession, and landslides (Oregon 2000b).

5.8.2. Effects of Past Coastal Erosion Events

A beach alteration that affected erosion on the Sandy Point Peninsula was the excavation of the Sandy Point Marina entrance channel in 1958 (a project that was completed without a permit from the U.S. Army Corps of Engineers or any other permit). This excavation interrupted the historic southward littoral drift of sediment along the west shore of the Sandy Point Peninsula. Instead of accreting on the southern extent of the peninsula, an area locally known as the South Cape, the sediment is now deposited in the entrance channel and will eventually fill the channel. Without the historic flow of sediment from the north, the formerly accreting South Cape has been eroding at a relatively high rate. The total horizontal erosion measured from 1962 to 2006 ranged between 0.5 and 64.8 feet at three transect sites along the South Cape, representing erosion rates of 0.0 to 1.2 feet per year (Johannessen 2006). The shoreline adjacent to the north side of the marina entrance has also been eroding at a high rate, ranging from approximately 4 to 5 feet per year over the 1962 to 1982 period. Over these same periods, the spit extending from the north side of the marina entrance (known locally as the “North Cape”) has been growing from approximately 9 to 12 feet per year (Johannessen 2003).

Past defenses against coastal floods along exposed Reservation shorelines has largely consisted of the construction of bulkheads, which have become larger and higher over the years, especially along the southern Sandy Point shoreline. These bulkheads extend below the high tide level and onto tribal tidelands, where they have resulted in substantial physical and biological damages. Physical damages that result from bulkheads include increased beach scour and erosion, a steeper beach profile (and therefore decreased tideland area), increased rate of net shore drift, coarser beach sediments, sediment impoundment along the up-drift side and landward of bulkheads, increased erosion along the down-drift extent of bulkheads (“end effects”), and loss of storm berm and beach resiliency. Biological damages caused by bulkheads include loss of habitat area, decreased and degraded shellfish habitat, likely loss of spawning habitat for surf smelt and sand

lance, increased predation of juvenile salmon, loss of beach stability, loss of organic debris on beaches, and unknown “threshold effects.” Ownership of the tidelands was the subject of three federal lawsuits (*United States v. Romaine*, 255 Fed. 253 [9th Cir. 1919]; *United States v. Stotts* 49 F.2d 619 [W.D. Wash. 1930]; *United States v. Boynton*, 53 F.2d 297 [9th Cir. 1931]) over the last century. Most recently, the bulkheads and other shore armoring were the subject of a federal lawsuit between the United States and the Lummi Nation versus the Sandy Point homeowners that was decided in favor of the Lummi Nation in the 9th Circuit Court in October 2009 after an appeal by the homeowners (*United States, Lummi Nation vs. Keith E. Milner and Shirley A. Milner, et al.*, Civil Action No. C01-809R [U.S. District Court, Western District of Washington]).

Several recent events of coastal erosion on the Reservation include that which occurred along the Sandy Point Peninsula in December 2000, along Lummi Shore Road in January 2003 and February 2006, and along Lummi View Drive in 2006. Figure 5.16 presents photographs of the erosion damage from the 2003 and 2006 Lummi Peninsula events. Photographs of erosion along the west beaches of the Lummi Peninsula and Sandy Point Peninsula are shown in Figure 5.7 and Figure 5.8, respectively. These events were described in detail in Section 5.4.1.3 on coastal flooding and are summarized, along with other recorded erosion processes, in Table 5.12.

5.8.3. Coastal Erosion Vulnerability Assessment

As described in Table 5.12, several coastal areas on the Reservation are vulnerable to erosion. The Lummi Water Resources Division has monitored and analyzed the entire shoreline of the Reservation to evaluate coastal erosion since the mid-1990s. Rates of erosion or accretion have been determined over several periods in an attempt to provide accurate estimates of future shoreline change. These periods were chosen based on the development history of each shoreline reach, literature-based assessments of shoreline processes, and the availability of high resolution land and shoreline surveys. Additionally, a qualitative assessment of the current and predicted future rates of change based on measured coastal erosion on the Reservation and observations of fetches and wave action has been developed (Johannessen 2007). This assessment is presented in Figure 5.17, which shows that the vulnerability to coastal erosion on the Reservation can vary significantly over short shoreline reaches. As presented in Figure 5.17, a high level of vulnerability is associated with erosion rates greater than -0.6 feet per year, a moderate level of vulnerability is associated with erosion rates between -0.6 to -0.3 feet per year, and a low level of vulnerability is associated with erosion rates equal to or less than -0.2 feet per year. Reaches that have negligible erosion, accretion, or mixed erosion and accretion are associated with a low level of vulnerability.

Of the six assessment areas on the Reservation, the Sandy Point Peninsula with its exposed, low-lying shorelines has the highest level of vulnerability to coastal erosion. The Lummi Peninsula also has exposed reaches of eroding shoreline that have low to moderately dense development, while the densely developed Gooseberry Point is only moderately affected by erosion. A shoreline reach of the Northwest Upland has moderate coastal erosion, but this reach is only lightly developed. Portage Island has several exposed shoreline reaches that are eroding, but there are no structures on the island at this time.

Due to the maritime traditional way of life of the Lummi People, there are several cultural resources zones found along Reservation shorelines that are vulnerable to coastal erosion.

However, only some shorelines with high erosion potential overlap with identified cultural resources zones.

5.8.4. Potential Coastal Erosion Losses

One estimate of potential erosion losses is provided by the benefits derived from a project designed to prevent coastal erosion. The total benefits gained from the Lummi Shore Road project (slope revetment, road improvements, and drainage improvements) were calculated to be \$742,600 per year (in 1997 dollars). Ninety-nine (99) percent of these benefits were associated with the avoided future cost of relocating the road and utilities away from the eroding bluff. With an average annual cost of \$636,000, the project had a benefit-to-cost ratio of 1.2 (Corps 1997). Phase 1 of the project was completed in December 1998 and protected 9,400 feet of Lummi Shore Road with a rock revetment along the toe of the bluff immediately adjacent to the road. Phase 2 of the project was completed in 2006 and relocated approximately 0.6 miles of Lummi View Drive away from the shoreline. In 2008, a 10-year shoreline change evaluation was completed (Johannessen 2008). The study found that the goal of maintaining 30,000 square feet of forage fish spawning habitat was attained, but that continued beach nourishment and revetment maintenance will be necessary to meet goals set for the future.

Along the Sandy Point Peninsula, the west shore and the South Cape have high erosion rates that have damaged or threaten to damage the structures along the shore. Continued erosion will make this area more vulnerable to coastal flooding in the future. Erosion of the toe of the bluff above West Beach on the Lummi Peninsula is increasing the landslide hazard along this shoreline reach (see Section 5.11). Continued erosion and a lack of mitigation actions could eventually lead to the complete loss of the threatened structures.

The potential total losses for the five developed assessment areas are estimated in Table 5.13. For these estimates, the measured erosion rates shown in Figure 5.17 for each shoreline reach were applied to an expected average structure lifespan of 50 years. For instance, a moderate erosion rate of -0.5 feet per year would equate to -25 feet of horizontal erosion over 50 years, whereas a low erosion rate of -0.2 feet per year would equate to -10 feet of horizontal erosion over the same time period. All structures that are located within these erosion buffers are considered to be endangered by coastal erosion. This approach represents a change from the 2007 update, which applied a 200 foot buffer to all reaches and considered all structures within this buffer that were also in the moderate to high erosion zones as being vulnerable to coastal erosion.

Table 5.12 Recorded Coastal Erosion Events on the Reservation

Date	Description
February 2006	Winter storm with southerly winds of 40 mph and gusts to 69 mph combined with high tides close to 10 feet; Whatcom County makes an emergency declaration; flooding at Gooseberry Point and Sandy Point Peninsula; south end of Lummi Shore Road covered with debris, undercut in some areas, and washed out in one area
2006	Portion of Lummi View Drive shoulder near the Little Bear Creek Elders Home became disconnected and fell to the beach below; sewer force main exposed
2006	Eastern end of Lummi View Drive from the Stommish Grounds to the intersection with Lummi Shore Drive moved inland
January 2003	Southerly winds generated waves that flooded the Lummi Peninsula shoreline at Gooseberry Point and Hermosa Beach; shoulder along approximately 1.5 miles of Lummi Shore Road undercut in several sections (no damage to the road surface)
December 2000	High tide and strong northwesterly winds drove large waves into the west shore of the Sandy Point Peninsula; waves eroded sediments supporting and behind bulkheads and decks; damages included 6 failed bulkheads, 7 damaged bulkheads, 18 bulkheads with settled rip-rap, 6 flooded houses, 9 nine damaged houses, 16 destroyed decks, and 35 properties (of 35 surveyed) flooded and contained overwash debris (Johannessen 2000a)
December 1997	Coastal storm eroded the bank along Lummi View Drive, causing a large portion of the road shoulder to fall to the beach below; 150-foot section of a force sewer line, the primary collector line from the west side of the peninsula, was nearly exposed and very vulnerable to further erosion; emergency placement of a shore-armoring revetment was conducted to protect the road
1990s-Present	Erosion along Lummi View Drive on the Lummi Peninsula threatens the road; project to relocate approximately 0.6 miles of the road away from the bluff is completed during 2006
1990s-Present	Erosion along West Beach on the Lummi Peninsula threatens homes near the edge of the bluff; one home moved inland in 2002
1990s-1998	Coastal erosion severely damaged Lummi Shore Road, causing dangerous driving conditions due to the undercut roadway; traffic reduced to one lane in several locations; utilities that parallel the road (i.e., water main, sewer force main, sewer gravity lines, sewer pump stations, and power and communications lines) threatened; estimated 8,600 cubic yards eroded per year from the bluffs along Lummi Shore Road; in December 1994, an emergency rock revetment project was completed by the U.S. Army Corps of Engineers to protect approximately 2,500 feet of shoreline along Lummi Shore Road; in December 1998, approximately 9,400 linear feet of additional rock revetment was installed along Lummi Shore Road by the Corps; associated monitoring and beach nourishment activity is ongoing



(a) View South along Lummi Shore Road, Hermosa Beach Area (January, 2003)



(b) View North along Lummi Shore Road, Hermosa Beach Area (January, 2003)



(c) View at the Intersection of Lummi View Drive and Lummi Shore Road (February, 2006)



(d) View South along Lummi Shore Road, Hermosa Beach Area (February, 2006)



(e) View Northwest along Lummi View Drive, Road Shoulder Erosion (2006)



(f) View Northeast along Lummi View Drive, Road Shoulder Erosion (2006)

Figure 5.16 Erosion Damage along Lummi Shore Road and Lummi Shore Drive, 2003 and 2006

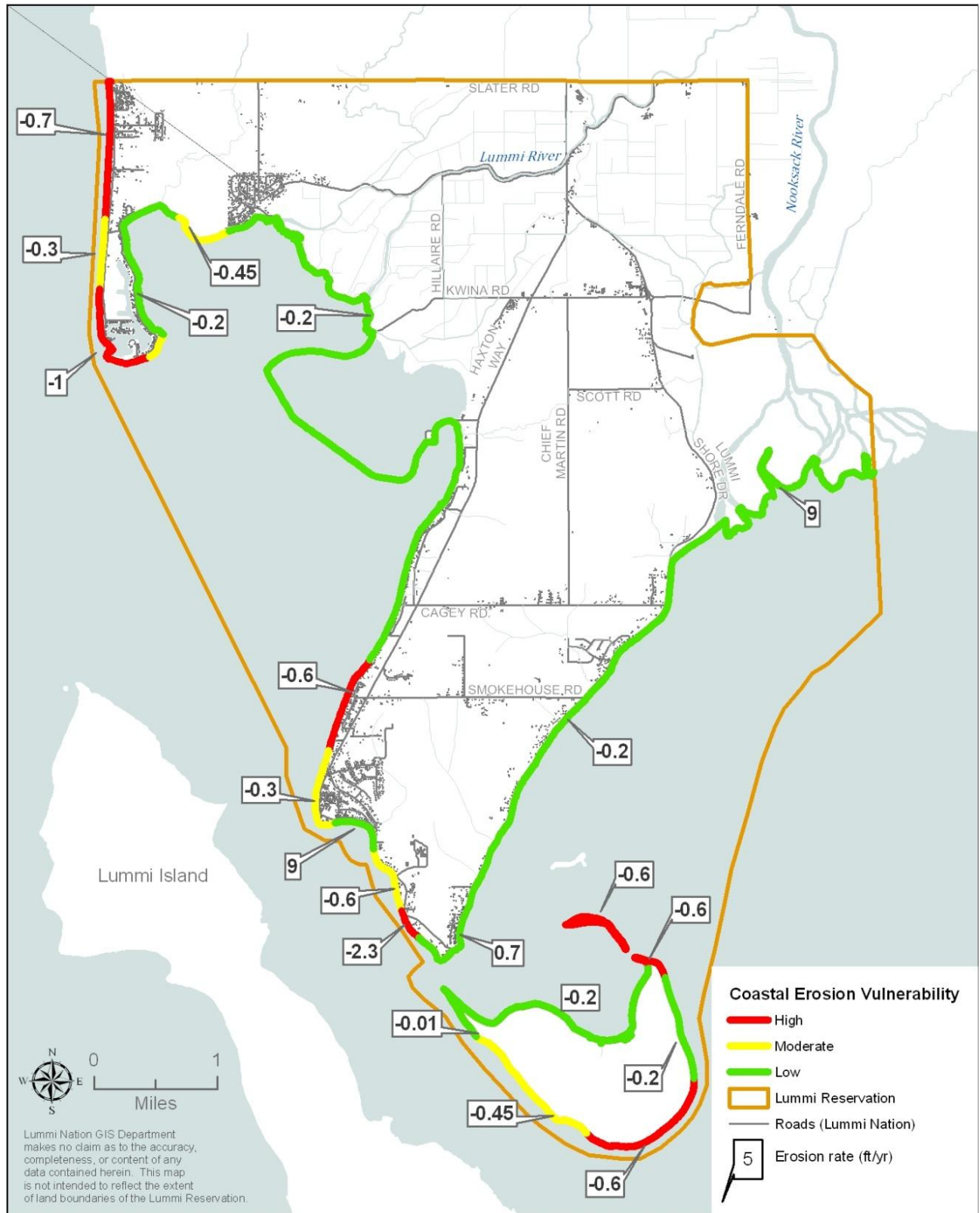


Figure 5.17 Estimated Coastal Erosion Vulnerabilities along Reservation Shorelines

Table 5.13 Vulnerability and Potential Losses of Structures to Coastal Erosion

Assessment Area	Estimated Vulnerability	Number of Structures	Structure Losses ¹	Contents Losses ²	Location/Comment
Lummi Peninsula	Low to High	0	0	0	▪ Coastal erosion endangers beach stairs and similar but not buildings
Floodplain	Low	0	0	0	▪ No structures near eroding shoreline
Northwest Upland	Low to Moderate	0	0	0	▪ No structures near eroding shoreline
Portage Island	Low to High	0	0	0	▪ No structures
Sandy Point Peninsula	High	8	\$1,343,751	\$671,876	▪ Homes along western and southern shorelines
Gooseberry Point	Moderate	5	\$14,727,960	\$56,570	▪ LIBC Fish Buying Station and Pier, LCC Dock and Dock Office, Whatcom County Ferry Terminal
Total		13	\$16,071,711	\$728,446	▪ Total Erosion Loss: \$16,800,157

¹Potential structure losses estimated as 100 percent of total structure value

²Potential contents losses estimated as 100 percent of total contents value

5.9. Drought

Although the Pacific Northwest is famous for its rainy climate, droughts are still a frequent occurrence across the region. In this section, past drought events, drought vulnerability, and potential drought losses on the Reservation are described.

5.9.1. Profiles of Drought Hazards

Drought is a condition of dryness resulting from a long period of abnormally low precipitation that is severe enough to reduce soil moisture, water, and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Unlike most natural disasters, droughts typically occur slowly, but can last for extended periods of time. Over the past century, the Pacific Northwest has experienced many drought episodes, including several that lasted for more than a single season (e.g., 1928-32, 1992-94, 1996-97). The most severe Washington State droughts on record occurred in 1977, 2001, and 2005 (WEMD 2008). The severity of a drought depends upon the degree and duration of low precipitation and the size of the affected area. Depending upon its severity, a drought can have a widespread impact on the environment and the economy. The economic impacts of drought occur primarily in the agriculture, forestry, and energy sectors. Irrigated and non-irrigated agricultural operations alike are vulnerable to and often adversely affected by drought conditions. Drought also increases the threat of wildfire, which can result in substantial losses of harvestable timber. Many areas experience increased erosion following a wildfire. Increased sedimentation can cause significant damage to aquatic ecosystems, irrigation systems, and energy development facilities. Reduced hydroelectric power generation and increased energy costs during drought have resulted from both the direct effects of decreased water availability and storage and the indirect effect of reservoir sedimentation.

Social and environmental impacts are also significant, although it is difficult to assign a precise monetary cost associated with these impacts.

Drought can also reduce groundwater resources, although there is generally a time lag between when surface water impacts are observed and when groundwater impacts are observed. Reduced replenishment of groundwater can lead to a reduction in groundwater levels and associated problems with reduced pumping capacity, dry wells, and, in coastal areas, saltwater intrusion. Reduced groundwater levels can also affect surface waters. For instance, the flow in some streams is generated by groundwater and can be particularly important during the summer months when precipitation is seasonally low and discharge from snowmelt slows.

Finally, it is important to note that climate change impacts in the Pacific Northwest include changes in the seasonality of precipitation, which is likely to result in generally drier summers and generally wetter winters. Given these conditions, the frequency and intensity of summertime drought is expected to increase over the coming decades.

5.9.2. Effects of Past Drought Events

The National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln has compiled drought data for 1895-1995 and has determined the percentage of time over this 100 year period that various regions of the United States experienced drought conditions (based on the Palmer Drought Severity Index). These data indicate that the Reservation suffered severe drought for 5-10 percent of the time from 1895-1995 (NDMC 2003). For the decade from 1985-1995, the Reservation had severe drought conditions for 10-20 percent of the time. By comparison, the majority of the agricultural and hydroelectric areas of eastern Washington were in severe or extreme drought for greater than 30 percent of the time from 1985-1995 (NDMC 2003). Drought events that have affected Washington State over the past century are described in Table 5.14. Although not all of these regional droughts affected the Reservation directly, there were likely indirect economic impacts on the residents of the Reservation. The impacts of the November 2000 to October 2001 drought (a.k.a., the “2001 drought”) on the Reservation are described in further detail here.

The 2001 drought began with unusually dry conditions during November and December of 2000. Dry conditions persisted through January and February of 2001, until returning to normal in March 2001. Because of the low precipitation and snow accumulation over the winter (approximately 60 percent of normal levels), much of Washington State had a significant water supply deficit by mid-March 2001. The poor outlook for summer water supplies raised concerns that low river flows would reduce hydroelectric power production and put some threatened and endangered fish species at risk. In response, the Governor authorized the Washington State Department of Ecology (Ecology) to declare a statewide drought emergency on March 14, 2001. The drought emergency declaration formally expired on December 31, 2001, after above average precipitation in the final two months of the year.

During the 2001 drought, the central part of the state, from the crest of the Cascade Mountains to the east banks of the Okanogan and Columbia rivers, were the most impacted by water shortages. As detailed by Hart et al. 2001:

- Energy – The drought decreased river flows, resulting in less electrical power generation and tighter power supplies. Available out-of-state power was extremely expensive, causing higher rates and financial emergencies at many utilities. The Bonneville Power Administration paid electricity-intensive industries to shut down. Many small-scale power generators were placed into emergency service throughout the state.
- Agriculture – With streamflow below half of normal flow levels and groundwater levels threatened, there was significantly less water available for irrigation. About 70 percent of the crops in Washington are produced on irrigated land, which represents about 27 percent of state cropland.
- Fish – To help Columbia River fish populations, the Bonneville Power Administration paid growers in the basin to remove 75,000 acres from agricultural production to keep additional water in the river during the most critical drought months. Improvements were made at a number of hatcheries, and salmon and steelhead were moved out of two hatcheries with water problems.

In the Nooksack River for the 2001 water year (October 2000 to September 2001), annual total runoff and mean streamflow was 67 percent of average (from 1967-2001 period). Mean streamflow during the months of November, December, and February were less than 50 percent of average for the 35 year period of record, with the February flow being the record low. Streamflow for November through April, July, and September were all less than 75 percent of average (USGS 2003c). These low flows have adverse effects on fish, including reduced habitat, increased pollutant concentrations, and higher stream temperatures in July and September. The low summer flows may have also impacted agricultural water supplies. In addition to the negative impacts to salmon, other effects of the 2001 drought on the Reservation were due to the reduced availability and increased price of power. For example, the Alcoa-Intalco Works aluminum smelter located just north of the Reservation, which plays a significant role in the local economy, was shutdown from May 18, 2001 to April 30, 2002 due to high energy costs. This resulted in lost wages and resultant economic activity in the area.

Table 5.14 Recorded Drought Events in the Reservation Region¹

Date	Description
April 2015 – Present	Water supplies across the state approximately 75 percent of normal levels; projected snowmelt runoff from April-September, 2015 expected to be lowest on record in over 60 years; Governor issues emergency drought declaration in several western and central Washington Water Resources Inventory Areas (WRIAs) on March 3, 2015; drought declaration expanded to include several additional WRIAs, including WRIA 1 (Nooksack River) in Whatcom County, on April 17, 2015; statewide drought declaration announced May 15, 2015; drought relief efforts currently underway
July 2006 – August 2006	Driest July and August on record in Bellingham (0.17 inches of rain)
March 2005 – December 2005	Less than 75 percent of normal water supplies across Washington State; extreme drought conditions in central Washington, moderate to severe drought conditions in eastern Washington; conditions in much of western Washington were abnormally dry, particularly in the Nooksack, Puyallup, and Skagit River basins; daily record low flows recorded on September 26, 2005 at the South Fork Nooksack River gauge below Cascade Creek and at the Nooksack River gauge near Ferndale; statewide drought emergency declared on March 10, 2005, making \$2.1 million from Drought Preparedness Account available; 2005 legislature authorized and additional \$8.2 million in emergency funding; Ecology processed 144 requests (85 percent approved) for emergency water rights; drought emergency declaration expired on December 31, 2005
November 2000 – October 2001	Drought across Washington State with precipitation from 56-74 percent of normal; some irrigation water right holders received only 37 percent of their normal water supplies, allowing other water right holders to get their needed supply; at the end of the irrigation season, 50,000 acre-feet of water was in storage in the five U.S. Bureau of Reclamation reservoirs in eastern Washington, compared with 300,000 acre-feet typically in storage; over \$400 million paid to electricity-intensive industries to shutdown and remain closed for the duration of the drought, including the Alcoa-Intalco Works aluminum smelter located just north of the Reservation; over \$10.1 million in federal disaster aid provided to agricultural growers; over \$7.9 million in state funds paid for drought-related projects (e.g., providing irrigation water to farmers with junior water rights, increasing water in fish-bearing streams); 1,162 fires burned 223,857 acres, fire suppression cost Washington State \$38 million and various local, regional, and federal agencies \$100 million; Ecology issued 172 temporary emergency water right permits and changes of existing water rights
1988	Much of eastern Washington in severe drought for over 50 percent of the year
October 1976 – September 1977	Precipitation across the state from 50-75 percent of normal levels, and in parts of eastern Washington as low as 42-45 percent of normal; Washington State economy lost an estimated \$410 million over a two-year period; 1,319 forest fires burned 10,800 acres, fire suppression involved 7,000-person hours and cost over \$1.5 million; Ecology issued 517 emergency temporary groundwater permits; fish had difficulties passing through Kendall Creek, a tributary to the North Fork Nooksack River
January 1973 – August 1973	Dry conditions in the Cascades Mountains
June 1967 – August 1967	Drought occurred across Washington State
Spring 1966	Drought occurred across Washington State

Table 5.14 Recorded Drought Events in the Reservation Region¹

Date	Description
1952	With the exception of June, every month was below normal precipitation; most impacted areas were the Puget Sound and central Cascade Mountains
May 1938 – September 1938	Driest growing season in western Washington
April 1934 – March 1937	Longest recorded drought in the region; driest periods were April-August 1934, September-December 1935, and July-January 1936-1937
July 1930 – August 1930	Drought occurred across Washington State; most areas averaged 10 percent or less of normal precipitation
June 1928 – March 1929	Drought occurred across Washington State; most areas averaged less than 20 percent of normal rainfall for August and September and less than 60 percent of normal from June-March
July 1925	Drought occurred across Washington State
July 1921 – August 1921	Drought occurred in all agricultural areas across Washington State
August 1919	Drought and high temperatures occurred in western Washington
July 1902 – August 1902	Drought occurred in western Washington; no measurable rainfall from July-August

¹WEMD 2001, Hart et al. 2001, National Drought Mitigation Center 2003, OWSC 2006, Ecology 2005, Ecology 2015

5.9.3. Drought Vulnerability Assessment

The entire population on the Reservation is directly or indirectly vulnerable to drought events. Residents may be directly affected by a reduced water supply, which may result in reduced well production, dry wells, and/or saltwater intrusion, as well as potential water use restrictions and increased water rates. The potential reduction of groundwater due to drought could have significant negative impacts on the Reservation because over 95 percent of the potable water supply comes from the two potable aquifer systems found on the Reservation. Current problems with over-pumping and saltwater intrusion could be expected to worsen under drought conditions. As discussed previously, drought-induced low flows in the Nooksack River can negatively impact salmon production in the river. Salmon are important to the Lummi People both economically and culturally. The lack of harvestable salmon in recent years has had a large social effect on the Reservation because of reduced income, economic uncertainty, and an increase in the high rate of unemployment. Additionally, low water supplies could negatively impact the Lummi Nation salmon hatcheries that rely on surface and ground water flows to provide for hatchery needs. Residents may be indirectly affected by drought in several ways, including an increased cost of electricity if statewide hydroelectric power generation is reduced and the loss of farm production and income resulting from impacts to agriculture. Another indirect impact of drought is the increased risk of wildfire. Approximately 30 percent of the Reservation is forested and many of the homes on the Reservation are located along the urban-wildland interface. During a drought, many structures and forest-based cultural resources would be at an increased risk of fire.

Because the Reservation is a relatively small area, the severity of a drought will be equal across the six assessment areas of the Reservation. However, the direct effects of drought will vary with the availability and demand for water. Residents who rely on low production wells will be more vulnerable than those with more productive wells or those who are connected to the Lummi Tribal Sewer and Water District system. The majority of wells most vulnerable to drought occur on the Lummi Peninsula. With current land uses, the effect on agriculture will be limited to the floodplain area, the only area where commodity crops are currently grown on the Reservation.

5.9.4. Potential Drought Losses

Although drought impacts may be significant and far-reaching, quantifying the effects of potential impacts can be difficult because droughts vary in severity and duration and because many of the impacts are likely to be complex and/or indirect. Unlike other natural hazards, drought does not present a direct hazard to structures (other than the associated increased risk of wildfire). However, the impact of reduced water supply has the potential to affect all Reservation residents. Similarly, low streamflow in the Nooksack River could reduce salmon productivity. With current land uses, agricultural losses on the Reservation will be largely limited to the Floodplain assessment area, where approximately 3,000 acres are in production (e.g., corn, potatoes, hay, and pasture). Also of concern are droughts occurring in eastern Washington, which could potentially reduce hydroelectric power production and result in indirect economic effects on the Reservation.

5.10. Wildfires

Wildland fires (wildfires) can endanger the woodland and developed areas of the Reservation. In this section, past wildfire events, wildfire vulnerability, and potential wildfire losses on the Reservation are described.

5.10.1. Profiles of Wildfire Hazards

Wildfire is a natural part of ecosystem dynamics. However, wildfires, whether naturally occurring or caused by humans, can result in the uncontrolled destruction of forests, brush, field crops, grasslands, and any structures found within the affected area. The fire season on the Reservation region typically runs from May through October, but may be prolonged during dry periods. Factors affecting the vulnerability of an area to wildfire include the type and density of vegetative fuel, weather conditions, and topography. Factors affecting potential losses due to wildfire include the number and density of structures, distance of structures from fuels, and proximity to firefighting resources. Wildfires are often extinguished while they are still less than one acre in size, but have the potential to spread to thousands of acres and may require thousands of firefighters and several weeks to extinguish. Federal, tribal, state, county, city, and private agencies and private timber companies provide fire protection and firefighting services in the region (WEMD 2004). The Forestry Division of the Lummi Natural Resources Department has developed wildfire fighting capabilities over the past several years.

Many structures are located along the urban-wildland interface, which are some of the most fire-prone fuel areas on the Reservation. The term “interface” is used to describe areas where homes and other structures have been built on or adjacent to forests and rangelands. While the term is in common use, the situation is not truly an interface; there is no single identifiable line that

marks the interface, but rather an intermingling of homes and structures with natural cover or forestlands at various degrees of growth and complexity (Clackamas County 2002). This interface is not necessarily limited to remote areas, but occurs wherever development is interspersed with forestlands, a common feature on the Reservation.

It should be noted that the annual area burned by wildfire in the Pacific Northwest is expected to increase as a result of climate change. Changes in climate that affect wildfire activity include warmer and drier summers, which can decrease fuel moisture, and warmer and wetter winters, which can increase fuel availability. See Section 5.15 – Hazard Risk Assessment and Climate Change for more information.

5.10.2. Effects of Past Wildfire Events

Based on the accounts of Lummi Elders, early European explorers, and early photographs of the region, old growth forests of massive Douglas fir, western hemlock, spruce, and western red cedar dominated what was to become the Lummi Indian Reservation prior to 1850. One or more large wildfires swept through the Reservation area between 1850 and 1900, destroying nearly all the remaining old growth forests that had not already been cleared for agriculture. Since reforestation was not practiced at that time, pioneer tree species, such as alder, willows, and cottonwoods, soon replaced the conifer forests and dominated the landscape. Although there are conifer groves and Douglas fir plantations, the present day forests on the Reservation are largely comprised of deciduous trees. Other regions in the Pacific Northwest have experienced several severe fire seasons over the past century; however, there have been no major fires in the forests or grasslands of the Reservation region in recent years. Small fires occur on a nearly annual basis, but are typically extinguished by human intervention before they can expand into a major fire. Between 1970 and 2015, there were over 50 small wildfires on the Reservation ranging in size from 0.1 to 8 acres (DNR 2007, 2015a). Examples of such fires are presented in Table 5.15. Figure 5.18 shows the locations and sizes of fires recorded by the Washington State Department of Natural Resources (DNR) in the Reservation area from 1970 to June 2015 (DNR 2007, Dewees 2010, DNR 2015a).

5.10.3. Wildfire Vulnerability Assessment

Fire behavior calculations are based on three components, called the fire triangle, which are: (1) fuels, (2) topography, and (3) weather. According to the United States Forest Service (USFS) National Fire Danger Rating System, the fuels in the forested areas of the Reservation can be described as light to medium (based on the following fuel classifications: light, medium, heavy). In areas where deciduous trees are dominant, which comprises most of the Reservation's forestland, the fuel classes are light; whereas fuel classes are medium in areas dominated by coniferous trees. Across the Reservation there is relatively low topographic relief (less than 40 percent) and a relatively infrequent occurrence of critical fire weather. For all of these reasons, the wildfire hazard in the forested areas of the Reservation is moderate in severity. Heavier fuel loads, steeper slopes, and/or higher critical fire weather frequency would be required for high or extreme fire hazard ratings. Similarly, a tool provided by FEMA that estimates the vulnerability of residential areas to wildfire using the Wildfire Hazard Rating Form derived from the Urban Wildland Interface Code estimates that the vulnerability to wildfire of forested residential areas on the Reservation is moderate. This result is largely due to light or medium fuels, slopes of 8

degrees or less, and the relatively close proximity of water sources for suppression (FEMA 2001a).

The forested uplands of the Lummi Peninsula, Northwest Upland, and Portage Island assessment areas are vulnerable to wildfire. However, the lack of heavy fuels, gentle topography, and relatively cool, humid, maritime climate, as well as the implementation of burning bans and close proximity to firefighting resources makes the probability of a damaging wildfire relatively low throughout all assessment areas on the Reservation. In the rare instances where wildfires occur, they are generally slow to spread and quickly contained by firefighters. A large, damaging wildfire on the Reservation would probably require a combination of relatively rare conditions, including an extended dry period, high air temperatures (to dry fuels), and high winds (to spread the fire faster than it could be contained). As such, structures located in the Lummi Peninsula and Northwest Upland assessment areas have a moderate vulnerability to wildfire. Although Portage Island also has a moderate vulnerability to wildfire, there are currently no structures located on the island. It should be noted that some cultural resources are forest-based or are located in forested areas and could be damaged or destroyed by wildfire.

The Sandy Point Peninsula, Gooseberry Point, and Floodplain assessment areas have a low vulnerability to wildfire because forestlands in these areas is limited in extent and generally not located in close proximity to buildings. There is a small fire hazard associated with the grasslands of the Sandy Point Peninsula and Floodplain areas. Figure 5.19 shows the estimated vulnerabilities to wildfire on the Reservation. These vulnerabilities align with those determined by the Washington State Department of Natural Resources (Titus 2003, DNR 2003, DNR 2007).

The risk to the Lummi Nation of wildfire damages and losses has been partially mitigated through firefighting preparedness and public education. The Forestry Division of the Lummi Natural Resources Department receives annual funds from the Bureau of Indian Affairs for forest protection and has used this funding to train staff and purchase firefighting equipment. Numerous members of the Lummi Natural Resources Department are trained in the Incident Command System (ICS). The Forestry Division implements and updates the Lummi Nation Forest Management Plan, issues burning permits, sets and announces burn bans, and provides wildfire information for public education.

5.10.4. Potential Wildfire Losses

If a wildfire that could not be quickly contained did occur on the Reservation, many structures along the urban-wildland interface would be at risk. Table 5.16 provides an estimate of the number of structures in each assessment area of the Reservation that are in close proximity to forestland, as well as the estimated total replacement value of these structures and contents. Because the total loss of some or all structures would only result from an infrequent, severe wildfire, the estimated potential losses represent a long-term, worst-case scenario. Other wildfire losses could include the loss of or damage to harvestable timber and non-timber forest products, negative economic impacts, and loss of or damage to cultural resources.

Table 5.15 Recorded Wildfires in the Reservation Region¹

Date	Description
July 4, 2015	Wildfire on Portage Island caused by fireworks; Whatcom County Fire District 8, Washington State Department of Natural Resources (DNR), and Lummi Natural Resources Department (LNR) responded; approximately 8 acres burned; fire contained, monitoring continued for two months after mop-up completed
September 2009	Wildfire on fee land caused by faulty equipment
August 2009	Landowner burned garbage in a pit that was left unattended; 0.5 acres burned in the Lummi Shore Road area
August 2009	Arson fire to the Nooksack River logjam; no damage on land
July 4-5, 2009	Brush and beach log fire on Brandt Spit adjacent to Portage Island; LNR and DNR responded; fire contained and allowed to burn itself out; cause of fire undetermined, but fireworks or a beach fire and windy conditions were suspected
August 15, 2005	Wildfire of approximately 0.25 acres on trust property (parcel 2-U); DNR responded and extinguished the fire; cause of the fire was determined to be fireworks
August 18, 2005	Wildfire of approximately 0.10 acres on trust property (parcel 61); DNR responded and extinguished the fire; cause of the fire was determined to be fireworks
2004	Small beach fire on Portage Island; fire was contained by LNR and later extinguished by DNR
June 10, 1999	Large fire in the wooded Whatcom Creek Park in the City of Bellingham after 277,000 gallons of gasoline spilled into the creek from a ruptured Olympic Pipeline Company gas pipeline; resulting fire and explosion caused three deaths, damaged one home, and did considerable damage to the park and creek ecosystem; the Bellingham Fire Department responded
February 1997	A natural gas pipeline (Northwest Natural Gas) explosion and fire in a remote wooded area near Everson caused a small forest fire
1996	Human-caused driftwood fire on Portage Island; fire extinguished using a bucket brigade (Dunphy 2003)
1995	Wildfire on a steep slope on the southern half of Lummi Island; firefighting efforts included aerial drops, then allowed to burn out
August 4, 1994	During a drought, a lightning strike on Sumas Mountain ignited a 12 acre fire in a logged area that had been replanted; wildfire spread into nearby standing timber and burned 40,000 to 50,000 board feet of timber; DNR responded
August 1994	Small fire caused by a bonfire along Marine Drive at a beachfront site just east of the Reservation; fire spread along approximately 1 mile of shoreline and upland along the bluff to the east of the Cliffside area
August 20, 1993	Wildfire of approximately 1 acre extinguished on state land near Kendall along the North Fork of the Nooksack River
August 1992	Lightning strike ignites 40 acre wildfire east of Deming near the confluence of the main stem of the Nooksack River with the South Fork; nearly 200 federal and county firefighters respond at a cost of nearly \$500,000
August 1992	Wildfire burned 13 acres east of Glacier along the North Fork Nooksack River
August 12, 1990	Lightening caused 11 wildfires in the Mount Baker area near Glacier
September 1989	Approximately 18 acre wildfire in a clear-cut timber harvest on state and private timberland near Van Zant; firefighting efforts required 60 firefighters
August 1988	Quarter acre wildfire on the southwest side of Mount Baker; extinguished by 26 federal firefighters

Table 5.15 Recorded Wildfires in the Reservation Region¹

Date	Description
April 1987	Wildfire of 1.5 acres south of Larrabee State Park; volunteer firefighter suffered minor injuries
August 1985	Wildfire of 600 acres started by a tree blown onto a power line on Vedder Mountain approximately 6 miles east of Sumas; 350 firefighters from Washington and Oregon responded

¹Whatcom County 2002; Dewees 2007; Dewees 2010; DNR 2015a

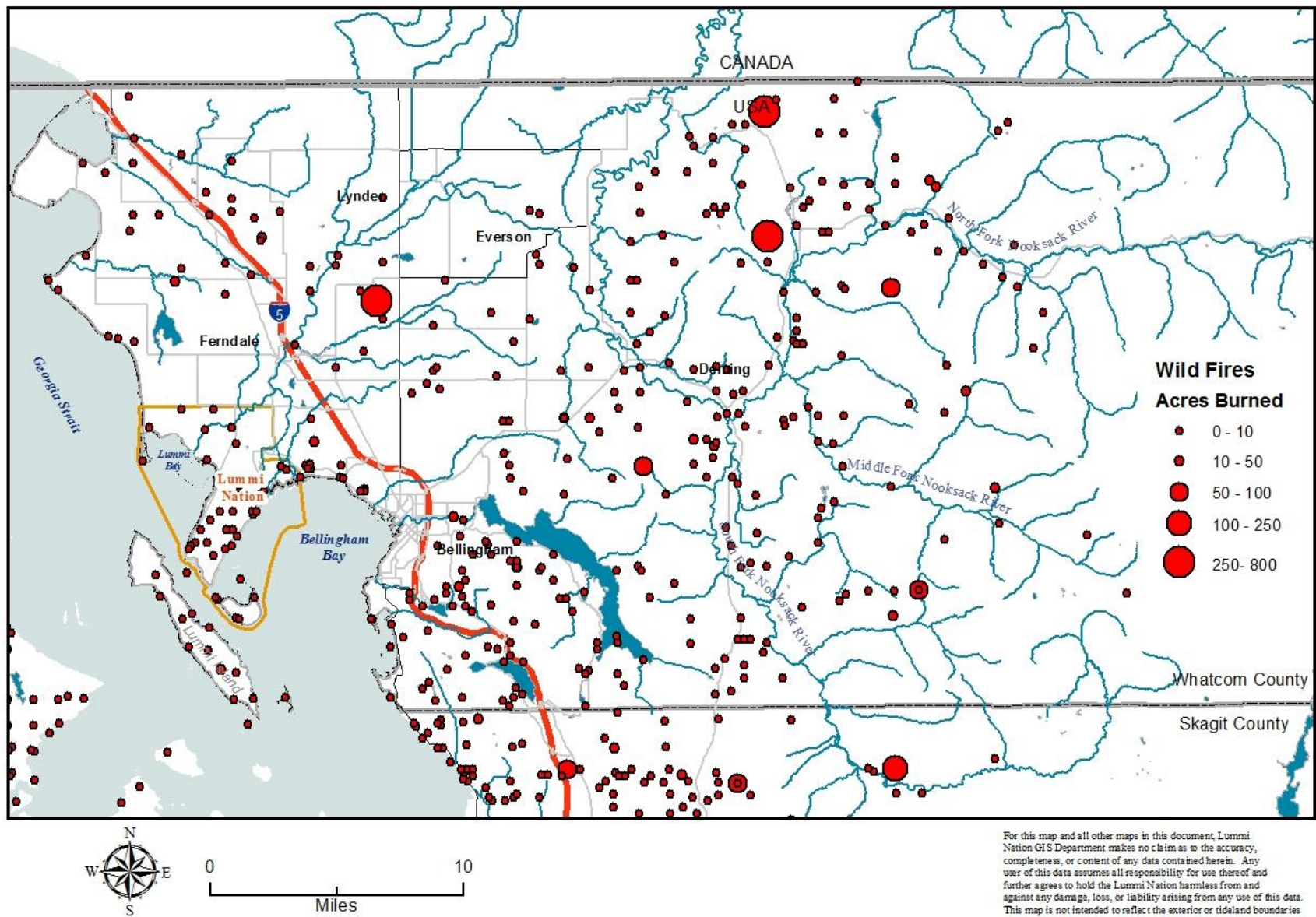


Figure 5.18 Recorded Wildfire Locations and Sizes in the Reservation Region, 1970 to June 2015

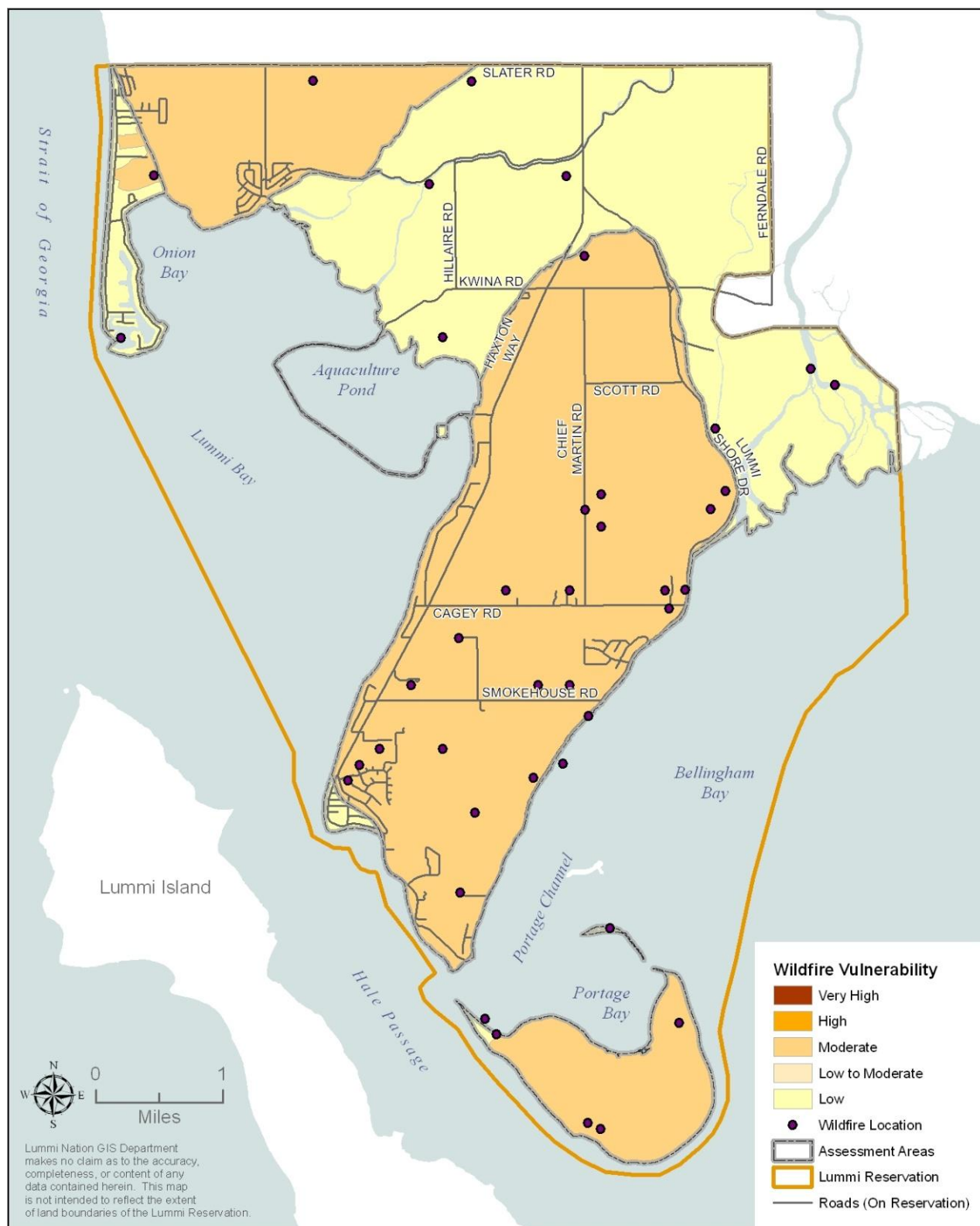


Figure 5.19 Estimated Wildfire Vulnerabilities and Locations of Recorded Wildfires in Reservation Areas

Table 5.16 Vulnerability and Potential Losses of Structures to Wildfires

Assessment Area	Estimated Vulnerability	Number of Structures	Structure Losses ¹	Contents Losses ²	Location/Comment
Lummi Peninsula	Moderate	1,271	\$288,147,689	\$76,948,746	▪ Most structures are in or adjacent to forest
Floodplain	Moderate	2	\$2,478,336	\$413,212	▪ Forested area adjacent to Lummi Peninsula ▪ Lummi Shellfish Hatchery
	Low	59	\$0	\$0	▪ Unforested
Northwest Upland	Moderate	423	\$30,764,306	\$14,034,653	▪ Largely forested
Portage Island	Moderate	0	\$0	\$0	▪ No structures
Sandy Point Peninsula	Moderate	9	\$1,249,425	\$624,713	▪ Forested area adjacent to Northwest Upland
	Low	491	\$0	\$0	▪ Unforested
Gooseberry Point	Low	131	\$0	\$0	▪ Unforested
Total		2,386	\$320,161,420	\$91,608,112	▪ Total Wildfire Losses: \$414,661,080

¹Potential structure losses estimated as 100 percent of total structure value in moderate vulnerability areas

²Potential contents losses estimated as 100 percent of total contents value in moderate vulnerability areas

5.11. Landslides

The topography of the Reservation is generally flat, but there are some steep slopes, particularly along marine shorelines, that are vulnerable to landslides. This section describes past landslide events, landslide vulnerability, and potential landslide losses on the Reservation.

5.11.1. Profiles of Landslide Hazards

A landslide is the movement of rock, soil, and/or debris down a slope that occurs when the materials comprising the slope can no longer resist gravity. Factors that influence landslides (e.g., soil composition and moisture, slope steepness, precipitation, land development and zoning practices, and seismic shaking) generally decrease the shear strength (resistance) of the slope materials and/or increase the shear stress (loading) to the slope. Saturation of slope materials with water, which can be caused by heavy or prolonged rainfall and/or where human activity has altered drainage patterns such that slopes are more likely to become saturated, can decrease slope shear strength. Undercutting of slopes by streams, waves, or construction activity can increase the shear stress and the likelihood of slope failure (landslide). Landslides occur without human influence, but can also be caused or exacerbated by human activities (Oregon 2000b; Ecology 2003a).

Landslides encompass a wide range of slope movements, from small rock falls to the failure of entire mountainsides; multiple landslides types may occur within a single event. The spatial extent of landslides also varies significantly, from square feet to square miles. In general, most

steep slopes are at some risk of slope failure, and some soil/geologic formations are particularly susceptible to landslide activity, even on relatively gentle slopes. For example, when layers of sand and gravel lie above less permeable silt and clay layers, groundwater can accumulate above the silt and clay layers and zones of weakness can develop. In the Puget Sound region, this combination is common and widespread (Ecology 2003a) and occurs on the Reservation.

The following characteristics are indicative of a landslide hazard area (WEMD 2001):

- Pre-existing landslide area
- Bluff retreat caused by erosion and sloughing of bluff sediments
- Vertical bluff face with little vegetation (as a result of bluff retreat)
- Tension or ground cracks along or near the edge at the top of a bluff
- Structural damage caused by settling and cracking of building foundations
- Toppling, bowed, or jack-sawed trees
- Gullying and surface erosion
- Mid-slope groundwater seepage from a bluff face
- Topographic convergence (especially as slope increases)

It should be noted that the risk of landslides in the Pacific Northwest is expected to increase as a result of climate change. On the Reservation, the increased landslide risk may result from increased coastal erosion as a result of accelerated sea level rise and/or decreased slope shear strength as a result of wetter winters and an increasing frequency of heavy rainfall events. See Section 5.15 – Hazard Risk Assessment and Climate Change for more information.

5.11.2. Effects of Past Landslide Events

In general, coastal bluffs in Puget Sound are recognized as unstable (WEMD 2001, Ecology 2003a). The primary landslide hazard areas that threaten public safety and structures on the Reservation occur along marine shorelines where relatively tall and steep bluffs are located. Landslides have threatened and/or damaged private property, residences, and public roads along the shoreline of the Lummi Peninsula.

Lummi Shore Road and Lummi View Drive are located on the Lummi Peninsula along the marine shoreline of Bellingham Bay and Hale Passage, respectively. In many places, both of these roads are located at or near the top of the bluff along the shoreline. During the 1990s, Lummi Shore Road was reduced to one lane in up to ten places because of the retreat of the shoreline and subsequent undermining and loss of the roadbed. School buses were not allowed to travel portions of Lummi Shore Road. Poor drainage associated with Lummi Shore Road, combined with wave-caused erosion of the base of the bluff, contributed to the rapid retreat of the shoreline and subsequent undermining of Lummi Shore Road. Mitigation of this problem was a multi-year and multi-million dollar project involving armoring of the shoreline, beach nourishment (and associated maintenance and monitoring), realignment of the roadway, and much improved storm water drainage along the road (additional details in Section 5.8). The second phase of the project, completed in 2006, was the creation of an inland replacement for a

portion of Lummi View Drive and abandoning a portion of the previous alignment that was at risk of being lost due to failure of the bluff below the road.

Also along the Lummi Peninsula marine shoreline, bluffs up to 100 feet high occur immediately north of Gooseberry Point along Lummi Bay. This area is called “West Beach” on USGS quadrangle maps. Bluffs along this unstable shoreline have experienced landslides associated with poor residential development practices and shoreline erosion. In the winter of 2001, during a storm with heavy rains and strong winds from the northwest, at least five landslides occurred in this area. Two of these landslides are shown in Figure 5.20 and are described below.

In one instance, storm water generated in a development near the shoreline was concentrated and then discharged to a property that slopes towards the bluff. The storm water saturated the bluff and the bluff failed (Figure 5.20a). Fortunately, the home at this location is not located adjacent to the bluff. In another instance, landslides occurred that directly threatened a residence (Figure 5.20b). At this site, the remaining slope to the beach was nearly vertical and tension cracks continued under the foundation of the home. The house was subsequently moved further away from the bluff. Many other homes in this area are at risk of landslides because the bluff is relatively high, composed of materials with weak shear resistance (sand and gravel), and vulnerable to wave erosion at the base of the bluff. There are also records or evidence of landslides along the coastal bluffs extending north from the Reservation along the Strait of Georgia. The Coastal Zone Atlas of Washington (Volume 1, 1979) shows the locations of these past landslides as well as indicating whether slopes are stable, intermediate, or unstable. This atlas identifies the slope in the Northwest Upland above Neptune Beach as intermediate in stability (Ecology 2003b).



Figure 5.20 Landslides at West Beach, Lummi Peninsula

The Lummi Nation may also be indirectly impacted by landslides that occur upstream in the Nooksack River basin. For instance, there were concerns that the May 31, 2013 landslide event (debris flow approximately 3 miles long) that occurred on the Middle Fork Nooksack River may have negatively impacted water quality, degraded salmon habitat, and disrupted steelhead

spawning (Bellingham Herald 2013). Subsequent landslides at this site occurred on June 1 and June 6, 2013. Landslides in steep mountain terrain with unconsolidated soils are not uncommon, particularly when soils become saturated following periods of heavy or prolonged precipitation.

It should also be noted that two regionally significant, deep-seated landslides occurred over the 2010-2015 update period: (1) the SR 530 Landslide (a.k.a. Oso Landslide or Hazel Landslide) and (2) the Ledgewood-Bonair Landslide (a.k.a. Whidbey Island Landslide). Although these landslides did not directly impact the Reservation, they illustrate the potential for landslide hazards that are shared throughout the Puget Sound region. The SR 530 Landslide occurred on March 22, 2014 near the small town of Oso on the North Fork Stillaguamish River. The landslide was one of the largest in Washington State history, with an estimated volume of 10 million cubic yards and an impact area of approximately one square mile (DNR 2015b). There were 43 fatalities and 49 homes were destroyed. Landslide debris also temporarily dammed the Stillaguamish River, causing flooding as far as 2.5 miles upstream, and blocked State Route 530, the primary transportation route between Arlington, Darrington, and Rockport, for two months before it could be cleared. The SR 530 Landslide occurred in an area that had been previously identified to be vulnerable to large landslides. Factors contributing to landslide initiation and mobility included above average rainfall during February-March 2014 (USGS 2015). Other potential contributing factors, such as forest practices, are currently under investigation. The Ledgewood-Bonair Landslide occurred on March 27, 2013 when a one quarter mile long section of coastal bluff collapsed. The total volume of the landslide was approximately 200,000 cubic yards. There were no injuries, but 1 home was substantially damaged, nearly 20 homes were cut off from outside access due to a damaged road, and 35 homes were evacuated. This landslide is part of a much larger landslide complex, which is approximately 1.5 miles long and 11,000 years old (DNR 2015b). Similar to the SR 530 Landslide, geologists had previously identified the areas surrounding the Ledgewood-Bonair Landslide and being vulnerable to landslide activity.

5.11.3. Landslide Vulnerability Assessment

The potential for landslides on the steep slopes of Reservation, most of which occur along marine shorelines, is high. These slopes are located within the Lummi Peninsula, Northwest Upland, Sandy Point Peninsula, and Portage Island assessment areas.

Because people commonly desire a home with a view, many structures have been built above, on, or below unstable slopes. A general lack of public awareness about unstable slopes and inconsistent slope mapping and land use regulations contribute to ongoing development in vulnerable areas (WEMD 2001). In addition, where steep slopes occur along shorelines, so-called protection measures employed to address the problem (e.g., bulkheads) can create and/or exacerbate problems elsewhere along the shoreline. While some protection measures are more effective than others (e.g., good storm water and vegetation management), none are completely effective at eliminating slope instabilities over the long-term. Additionally, because the location of weak layers in the sediments below slopes is uncertain or unknown, it can be difficult to identify slopes that are more prone to failure. As a result, the estimated landslide vulnerability presented in Figure 5.21 is based on a slope steepness of greater than 15 percent. To eliminate steep but small features (e.g., ditches) that pose no danger, only slope areas that extend over more than one acre were considered. Buildings that are located on these slopes or are located within 25 feet of an identified slope were considered to be vulnerable to landslides. The slope

steepness and extent was derived from 2005 30 foot pixel Light Detection and Ranging (LIDAR) data.

The overall landslide vulnerability of the entire Reservation is difficult to quantify because of the distribution of the hazard; much of the Reservation is at no or minimal risk of slope failure, but some areas are at significant risk of damage due to landslides. In several of the areas prone to landslides, expensive homes have been built at or near the top of bluffs to take advantage of the view of marine waters. For instance, there are 15-20 homes built near the edge of the bluff along West Beach, where bluff retreat is currently occurring and significant short-term and long-term coastal erosion and resultant landslides can be expected. Other susceptible areas are possible sites of cultural resources. Because the developed areas of the Reservation that are susceptible to landslide are relatively small (and not all sloped areas will have weak layers beneath them), the overall relative vulnerability to landslide on the Reservation is low to moderate. However, the probability of a damaging landslide in the identified landslide risk zones is high, especially if mitigation actions are not employed.

5.11.4. Potential Landslide Losses

Table 5.17 provides the number of structures that are located in landslide-prone areas and estimates of potential losses to landslide damage. To account for structures that are not located directly on a steep slope (greater than 15 percent grade) but that are vulnerable because of the close proximity to a slope, a buffer of 25 feet was applied around identified slope areas. Structure footprints that intersect the landslide buffer were considered to be in the landslide risk zone. This approach was instituted in 2010 and represents an improvement from the 2007 update, which only captured structures located directly on steep slopes. Potential losses were estimated as the total replacement value of structures and contents in the landslide risk zone. This approach assumes a worst-case scenario. In addition to landslide damages to structures, cultural resources located in or near the landslide risk zone may also be damaged, particularly along shoreline areas.

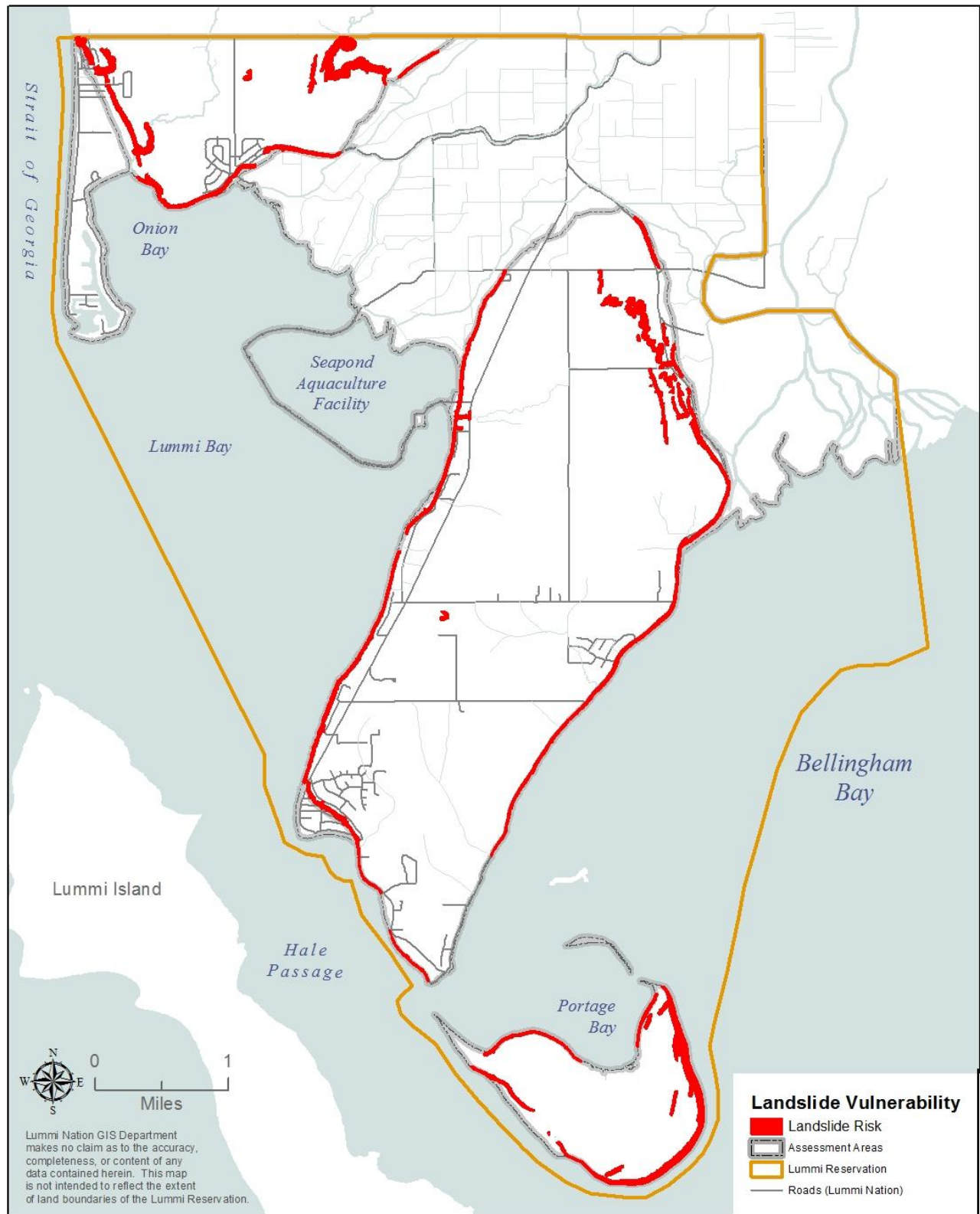


Figure 5.21 Estimated Landslide Vulnerabilities in Reservation Areas

Table 5.17 Vulnerability and Potential Losses of Structures to Landslides

Assessment Area	Number of Structures	Structure Losses ¹	Contents Losses ²	Location/Comment
Lummi Peninsula	85	\$10,831,070	\$5,415,535	<ul style="list-style-type: none"> ▪ Several locations along the shoreline ▪ Includes one LTSWD wastewater pump station
Floodplain	0	n/a	n/a	
Northwest Upland	36	\$5,287,824	\$2,643,912	<ul style="list-style-type: none"> ▪ Several locations in Sandy Point Heights
Portage Island	0	n/a	n/a	<ul style="list-style-type: none"> ▪ No structures
Sandy Point Peninsula	0	n/a	n/a	
Gooseberry Point	5	\$441,661	\$220,831	<ul style="list-style-type: none"> ▪ Some interior slopes
Total	126	\$16,560,555	\$8,280,278	<ul style="list-style-type: none"> ▪ Total Landslide Losses: \$24,840,833

¹Potential structure losses estimated as 100 percent of total structure value in landslide risk zone

²Potential contents losses estimated as 100 percent of total contents value in landslide risk zone

5.12. Tsunamis

Although there is no record of a tsunami hitting the Reservation shoreline in recent history, the possibility exists. In the following sections, past tsunami events, tsunami vulnerability, and potential tsunami losses on the Reservation are described.

5.12.1. Profiles of Tsunami Hazards

A tsunami (a.k.a., tidal wave) is a series of waves generated in a body of water by a sudden disturbance that vertically displaces the water column. Earthquakes, landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis. Tsunamis can travel for thousands of miles at speeds up to 600 miles per hour in deep water before slowing in shallow water as they approach the shore. The waves may hit the shore from 5 to 90 minutes apart, and the first waves are usually not the largest. The size of the waves can also vary greatly along a coastline (Manson 1998, FEMA 2003e). Large tsunamis have caused devastating loss of life and property damage throughout recorded history, particularly along the shorelines of the Pacific Ocean. Two recent examples include the Indian Ocean tsunami of 2004 and the Japan tsunami of 2011. On December 26, 2004, a magnitude 9.0 subduction zone earthquake in the Indian Ocean generated a tsunami that was up to 20 feet high and resulted in the deaths of over 230,000 people. On March 11, 2011, a magnitude 9.0 earthquake off the northeast coast of Japan caused a 33 foot tsunami. The disaster killed nearly 16,000 people, injured 6,000 others, and caused widespread damages, including the subsequent nuclear meltdown at the Fukushima Daiichi nuclear power plant.

5.12.2. Effects of Past Tsunami Events

The last known Cascadia Subduction Zone earthquake occurred on January 26, 1700 and generated a tsunami that inundated areas of the Washington and British Columbia coasts and traveled across the Pacific Ocean to Japan. Geologic evidence of the earthquake and tsunami that has been discovered along the west coast of North America includes formerly vegetated land that subsided, buried tidal marshes, layers of sand that were washed inland and covered by subsequent soil layers, and archaeological sites buried by tidal mud. In 2007, the dates of these geologic features were correlated with Japanese records of a tsunami that was not preceded by a perceived earthquake. These Japanese records describe a flood along the coast of Japan that drove villagers to high ground, damaged coastal structures and agriculture, sank ships, and killed sailors (Atwater et al. 2005b). Additionally, the oral traditions of the native peoples of Vancouver Island indicate that the same tsunami likely destroyed a winter village, with no survivors, at Pachena Bay on the west coast of Vancouver Island (GSC 2002a). In October 2008, U.S. Geological Survey geologist Brian Atwater and staff from the Lummi Natural Resources Department and the Lummi Nation Tribal Historic Preservation Office conducted field reconnaissance on the Reservation to find evidence of historical tsunami deposits on the Reservation floodplain. The results were inconclusive and it was determined that further investigation would be needed.

More recently, the 1946 magnitude 7.3 Vancouver Island earthquake caused one death due to drowning when a small boat capsized in an earthquake-generated wave. In 1949, the magnitude 7.1 earthquake near Olympia probably triggered a landslide three days later at the Tacoma Narrows that produced an 8 foot high tsunami in Puget Sound. Minor wave damage occurred to houses adjacent to the slide, but the opposite shore, hit by the larger wave, was undeveloped at the time (Noson et al. 1988). With increased development along shorelines since that time, a similar event could cause substantial damage today. In 1964, the most recent significant tsunami to hit Washington State caused \$105,000 in damage (mostly to bridges) along the Washington coast. This tsunami, generated by the Prince William Sound earthquake in Alaska, was much more destructive in California. The third and fourth waves (11 and 16 feet above tide level) to hit Crescent City killed 11 people and caused approximately \$7.4 million (1964 dollars) in damage (Manson 1998, FEMA 2003e). Table 5.18 lists regional and worldwide tsunami events since 1946.

5.12.3. Tsunami Vulnerability Assessment

The most probable and potentially greatest tsunami hazard on the Reservation is posed by a tsunami generated by a Cascadia Subduction Zone (CSZ) megathrust earthquake. Modeling completed by the Washington State Department of Natural Resources (DNR) indicates that a large tsunami from a CSZ earthquake could inundate the Sandy Point Peninsula, other low-lying Reservation shorelines, and the Lummi River and Nooksack River floodplains as far upstream as Ferndale (Figure 5.22). The model predicted worst-case scenario water depths from 3-16 feet in the Floodplain assessment area and from 3-6 feet on the Sandy Point Peninsula and portions of Gooseberry Point (Walsh et al. 2004). Because a CSZ tsunami would be generated by the subduction zone off the outer coast of Washington State, the anticipated warning and response time for the Reservation area would be 2-3 hours, possibly just long enough for evacuation of vulnerable areas (Walsh 2003).

Locally generated tsunamis within the Strait of Georgia or San Juan Island region probably represent a smaller, less likely, and less severe hazard than a CSZ event, but little is known about their history. For such a tsunami to occur, a "steep and deep" landslide must occur, that is, a large, steep bluff or hillside must fall rapidly into deep water, or a large, rapid underwater landslide must occur.

Although a locally generated tsunami could cause damage on the Reservation, tsunamis of distant origin in the ocean are unlikely to seriously affect the inner Puget Sound or the Strait of Georgia and therefore do not represent a significant hazard on the Reservation (Walsh 2003). A detailed but dated study on tsunamis of distant origin concluded that such tsunamis were unlikely to generate a 100-year flood event on the Reservation, both because of the predicted height of potential tsunamis and because the simultaneous occurrence of high tide and a storm surge or high, wind-generated waves with a tsunami was determined to be highly unlikely (Garcia and Houston 1975). However, geologists have greatly increased their knowledge of earthquake and tsunami events since the mid-1970s. Many new, major faults have been identified since 1975, including faults in the North Puget Sound and Strait of Georgia area. In general, the estimated risk of a significant tsunami in the area has risen in recent years (Johannessen 2000b).

Considering that only two locally generated tsunamis have been recorded over the last century in the Puget Sound/Strait of Georgia area, and that not all tsunamis are large enough to cause damage, it appears that a damaging tsunami event on the Reservation has a low probability. However, the Sandy Point Peninsula, Floodplain, and Gooseberry Point assessment areas are particularly vulnerable to a tsunami generated by a Cascadia Subduction Zone earthquake and tsunamis generated locally in the Strait of Georgia, which could have severe consequences in heavily developed, low-lying coastal areas. Cultural resources located within these assessment areas could also be impacted; damages would likely be similar to those sustained during flooding. Figure 5.23 shows the estimated relative tsunami vulnerabilities in the six assessment areas on the Reservation. Tsunami vulnerabilities were derived from the inundation model for a tsunami generated by a Cascadia Subduction Zone earthquake developed by the DNR.

The risk to the Lummi Nation of tsunami damages and losses has been partially mitigated through improved communications and public education. In 2006, Whatcom County coordinated the purchase of an All-Hazard Alert Broadcast (AHAB) tsunami warning system for the Sandy Point Peninsula. This system is installed at and activated by Whatcom County Fire District 17 and is part of the Washington State tsunami warning system. The Lummi Nation has purchased two additional AHABs through an Emergency Management Preparedness Assistance Grant (EMPAG) from the Washington State Emergency Management Division (WEMD) for the Reservation. These systems were installed in the floodplain and at the southern end of the Lummi Peninsula. Several NOAA weather radios were also purchased and placed in each of the LIBC government departments. An improved signal has been provided for these and other radios through the installation of a new weather and hazards transmitter in Blaine during 2006. Finally, the Lummi Nation has worked since 2005 with the DNR and the WEMD to develop tsunami evacuation route brochures for the Reservation. The final brochure is attached as Appendix F. This brochure was distributed to all Reservation residents during the summer of 2007 after the installation of the two additional AHABs. Tsunami evacuation signs were installed during the fall of 2009.

5.12.4. Potential Tsunami Losses

The potential losses from a tsunami on the Reservation are greater than those described previously for coastal flooding because the depths and velocities of flooding are potentially greater and over a much larger area. Depending on the severity of the event, damages may range from inundation of a handful of homes to destruction of many buildings. A large event could result in total loss of most buildings on the Sandy Point Peninsula, heavy damage to other buildings on the Sandy Point Peninsula, the boats anchored in the Sandy Point Marina (not included in the calculations), total loss or heavy damage at Gooseberry Point, and damage to the aquaculture dike in Lummi Bay, the Lummi Bay seawall, and properties in the Floodplain assessment area. Damage could also occur along Hermosa Beach and other low-lying shorelines along the Lummi Peninsula. Table 5.19 provides the number of structures potentially vulnerable to tsunamis and the estimated potential losses that would result from a worst-case scenario tsunami. For the purposes of this assessment, the worst-case scenario tsunami is defined as the total loss of structures and contents in areas determined to have moderate, high, or very high tsunami vulnerability.

Table 5.18 Recent Regional and Worldwide Tsunami Events¹

Date	Occurrence
April 1, 2014	Magnitude 8.2 earthquake in northern Chile generated a tsunami observed across the Pacific Ocean; 7 deaths and over 200 injuries reported as a result of ground shaking; tsunami damages to local ports
February 6, 2013	Magnitude 8.0 earthquake in the Solomon Islands generated a tsunami observed across the Pacific Ocean; 9 deaths and nearly 500 structures destroyed near the epicenter
October 28, 2012	Magnitude 7.7 earthquake in Haida Gwaii (formerly Queen Charlotte Islands), British Columbia, Canada; small, non-destructive tsunami measured from Alaska south to California and in Hawaii
March 11, 2011	Magnitude 9.0 earthquake off the northeast coast of Japan caused 33 foot tsunami; disaster killed nearly 16,000 people, injured 6,000 others, and caused widespread damages, including the subsequent nuclear meltdown at the Fukushima Daiichi nuclear power plant
February 27, 2010	Magnitude 8.8 earthquake offshore of the central coast of Chile generated 8.5 foot tsunami; over 330 dead and widespread damages due to ground shaking and tsunami
September 29, 2009	Magnitude 8.0 underwater earthquake in the Samoan Islands (Samoa and American Samoa); 4 waves between 15-20 feet high reached as far as 1 mile inland; at least 120 dead, widespread structural destruction
November 15, 2006	Magnitude 8.1 earthquake northeast of the Kuril Islands in Russia; West Coast and Alaska Tsunami Warning Center (WCATWC) advisory issued for the coastal areas from the California-Mexico border to Cape Flattery, Washington, watch issued for the Washington, British Columbia, and Alaska coastal areas from Cape Flattery, Washington to Sand Point, Alaska, and warning issued for the Alaska coastal areas from Sand Point to Attu; waves of ≤ 1.0 foot were observed in Alaska and Japan
July 17, 2006	Magnitude 7.7 earthquake beneath the Indian Ocean 150 miles southwest of Java generating a 6 foot high tsunami that hit the Java coast; 69 deaths reported
June 14, 2005	Magnitude 7.0 strike-slip earthquake 80 miles off of the northern California coast;

Table 5.18 Recent Regional and Worldwide Tsunami Events¹

Date	Occurrence
	WCATWC tsunami warning issued for the west coast of North America from the California-Mexico border to the northern end of Vancouver Island; warning was cancelled about one hour after it was issued
December 26, 2004	Magnitude 9.0 subduction zone earthquake in the Indian Ocean approximately 155 miles south-southeast of Banda Aceh, Sumatra; tsunami with waves up to 20 feet high, traveled over 1,000 miles to Sri Lanka and India; approximately 230,000 deaths in at least 11 countries; largest earthquake worldwide since the magnitude 9.2 Alaskan earthquake in 1964
July 1998	Magnitude 7.1 earthquake centered 12 miles offshore struck the northern coast of Papua New Guinea; waves up to 50 feet high reached the shore within 15 minutes, destroying several villages and killing more than 2,200 people
July 1993	Magnitude 7.8 earthquake in the Japan Trench generated a tsunami that struck the Japanese island of Okushiri; 200 deaths reported
August 1976	Magnitude 7.9 earthquake in the Philippines generated a tsunami struck coastline of the Moro Gulf in the North Celebes Sea; 5,000 deaths reported
March 1964	Magnitude 9.2 Prince William Sound earthquake in Alaska; waves up to 16 feet observed in Crescent City, California; 106 deaths from the tsunami and approximately \$7.4-\$16.0 million in damage
May 1960	Magnitude 9.5 subduction zone earthquake in Chile; tsunami alone caused over 183 deaths in Hawaii and Japan; over \$550 million in damages from earthquake and tsunami combined
1949	Magnitude 7.1 earthquake near Olympia triggered a landslide at the Tacoma Narrows producing an 8 foot high tsunami in Puget Sound
April 1946	Magnitude 7.3 Vancouver Island earthquake generated a tsunami that caused damage in Alaska and Hawaii; 159 deaths reported

¹ Gonzalez 1999, Noson et al. 1988, Manson 1998, FEMA 2003e, WEMD 2004, Atwater et al. 2005a, ITIC 2015

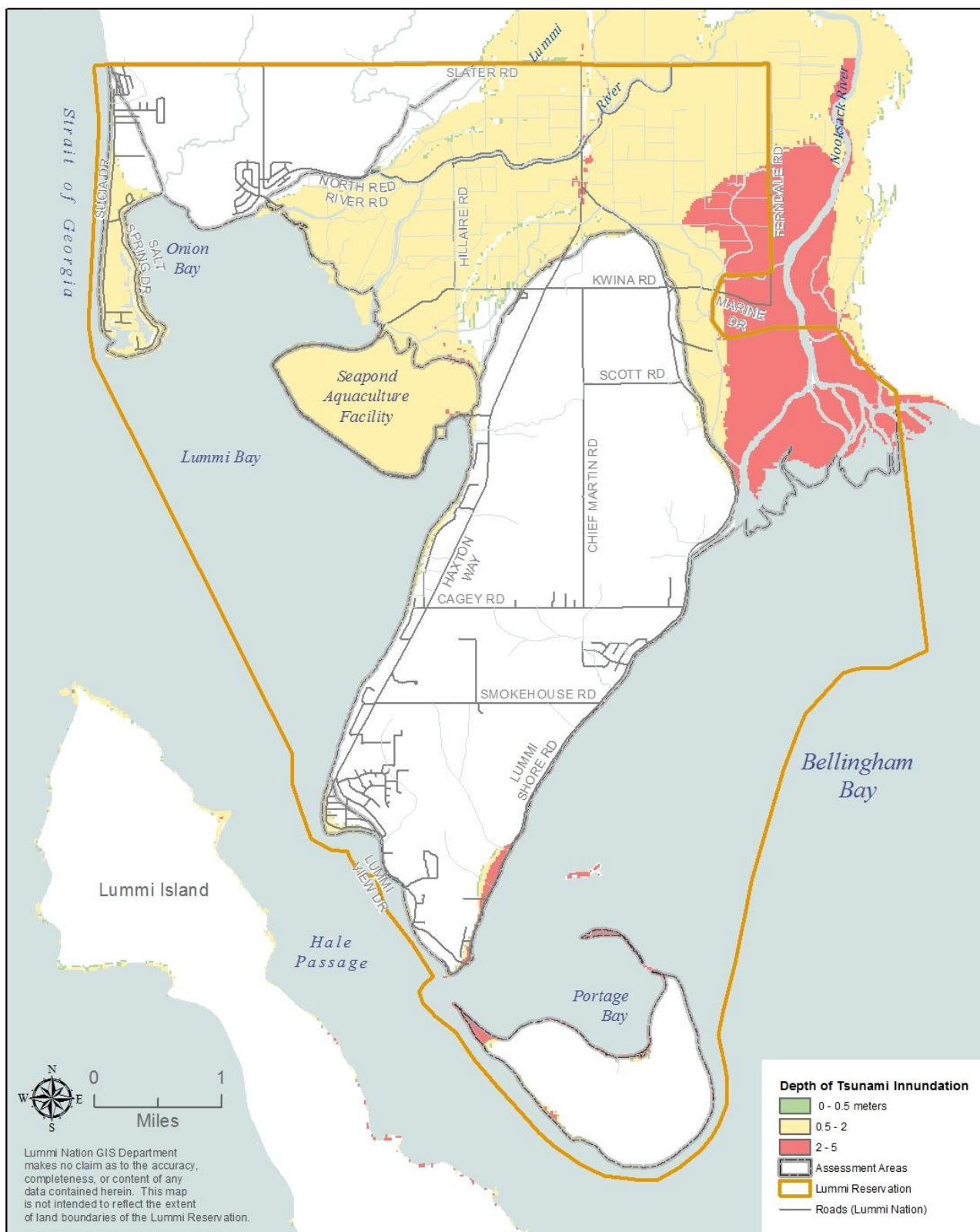


Figure 5.22 Modeled Tsunami Inundation in the Bellingham Area from a Cascadia Subduction Zone Earthquake

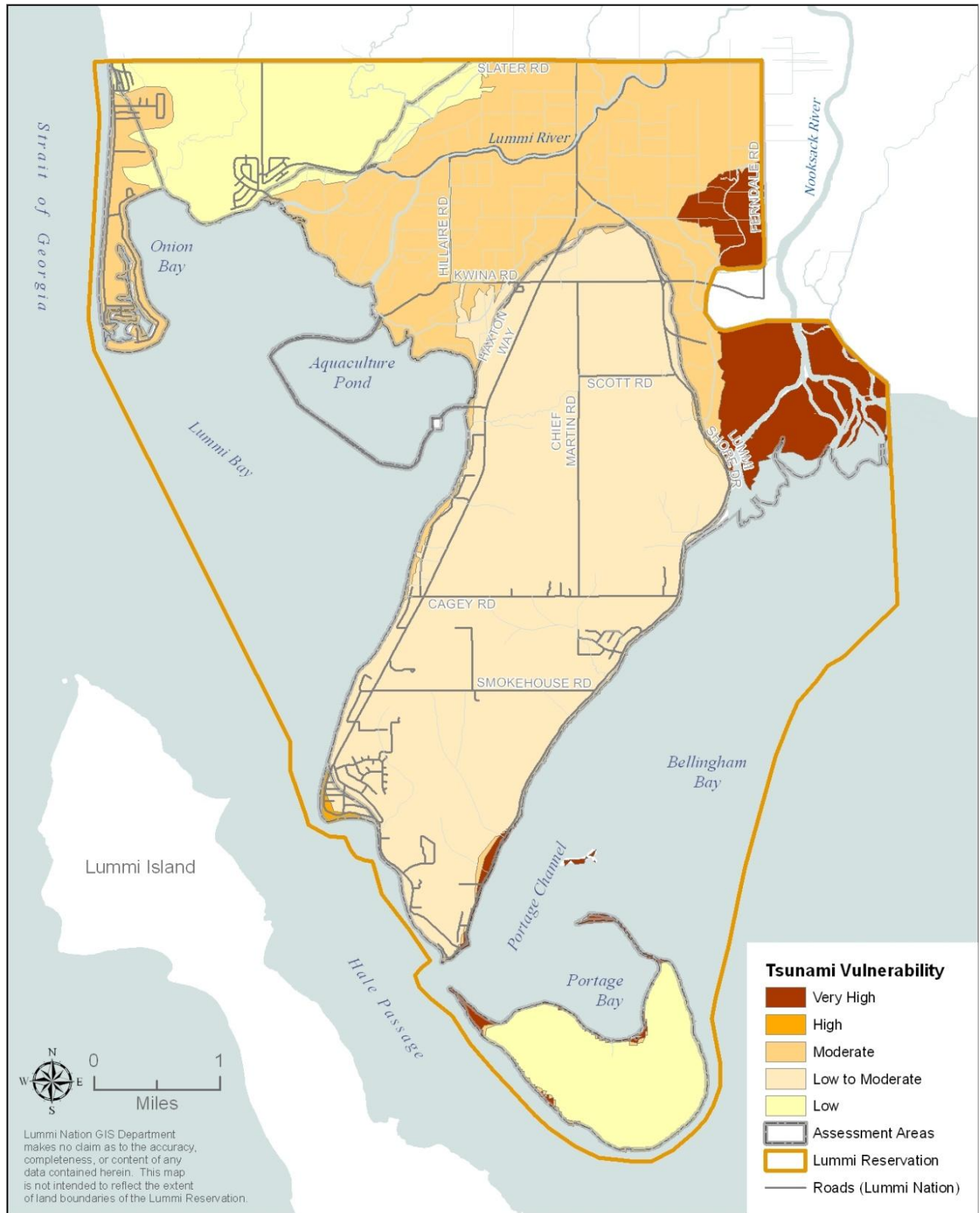


Figure 5.23 Estimated Tsunami Vulnerabilities in Reservation Areas

Table 5.19 Vulnerability and Potential Losses of Structures to a Tsunami

Assessment Area	Estimated Vulnerability	Number of Structures	Structure Losses ¹	Contents Losses ²	Location/ Comment
Lummi Peninsula	Very High	6	\$791,425	\$195,713	▪ Hermosa Beach area
	Moderate	73	\$10,355,641	\$4,977,821	▪ Robertson Road and Hermosa Beach areas
	Low to Moderate	1,183	\$0	\$0	▪ Isolation due to closed roads
Floodplain	Very High	2	\$233,804	\$116,902	▪ Nooksack River Delta
	Moderate	53	\$8,397,369	\$2,521,765	▪ Silver Reef Hotel, Casino & Spa and Lummi Mini-Mart not included, flood mitigation measures in place ▪ Includes Shellfish Hatchery and Lummi Bay Salmon Hatchery
	Low	4	\$0	\$0	
Northwest Upland	Moderate	55	\$5,394,192	\$1,722,096	▪ Residences at bottom of slope towards Sandy Point Peninsula
	Low	368	\$0	\$0	▪ Road detours are potential inconvenience
Portage Island	Very High	0	n/a	n/a	▪ No structures
	Low	0	n/a	n/a	▪ Uninhabited
Sandy Point Peninsula	Moderate	480	\$74,797,706	\$33,467,827	▪ Most of the Peninsula is vulnerable to flooding ▪ Includes Sandy Point Fire Station, Sandy Point Salmon Hatchery, Sandy Point Wastewater Treatment Plant
	Low	20	\$0	\$0	▪ Residences near border with Northwest Upland ▪ Road detours are potential inconvenience
Gooseberry Point	High	46	\$19,239,973	\$1,989,641	▪ Includes homes along shoreline, Fisherman's Cove Mini-Mart, LCC dock, office, and warehouses, and Whatcom County Ferry Terminal
	Low to Moderate	85	\$4,222,690	\$2,111,345	▪ Interior homes, outbuildings, and warehouses
Total		2,375	\$123,432,800	\$47,103,110	▪ Total Tsunami Losses: \$170,535,910

¹Potential structure losses estimated as 100 percent of total structure value in moderate, high, or very high vulnerability areas

²Potential contents losses estimated as 100 percent of total contents value in moderate, high, or very high vulnerability areas

5.13. Volcano

The Reservation is located in the relative vicinity of Mount Baker, an active volcano in the Cascade Mountain Range. In this section, past volcanic events, volcanic vulnerability, and potential volcanic losses on the Reservation are described.

5.13.1. Profiles of Volcanic Hazards

A volcano is a vent in the crust of the earth through which magma (molten rock), rock fragments, gases, and ash are ejected from the interior of the earth. A volcanic mountain is created over thousands of years by the accumulation of these erupted materials around the vent. Mount Baker is a 10,781 foot high volcano that lies approximately 37 miles due east of the Reservation. The volcanic hazards presented by Mount Baker include:

- **Lava flows:** Lava is molten rock that pours onto the Earth surface during an eruption.
- **Pyroclastic flows:** Pyroclastic flows are hot avalanches of lava fragments and volcanic gas formed by the collapse of lava flows or eruption clouds.
- **Tephra:** Tephra is fragments of rock that are blasted high into the air by explosive eruptions. Large fragments fall close to the volcano; small fragments (called ash) from the largest eruptions can travel hundreds or thousands of miles.
- **Lahars:** Lahars are fast moving slurries of rock, mud, and water that look and behave like flowing wet concrete. Landslides can transform into lahars. Pyroclastic flows can generate lahars by melting snow and ice.

Given the generally slow progression of most types of eruptive events and the high capacity of scientists to detect the early warning signs of an impending eruption (by monitoring earthquakes, ground deformation, and gas emissions), the evaluation of volcanic hazards is primarily that of predicting lahar, pyroclastic flow, and related flash flood paths based on topography and predicting ash fall patterns based on prevailing wind patterns. Lahars are the greatest concern at Mount Baker because of its history of frequent lahars and the ability of lahars to flow for tens of miles. Lahars generated by volcanic landslides can be triggered by eruptions, regional earthquakes, gravity, or increases in hydrovolcanic activity (i.e., steam generation) that is not associated with magma intrusion. When groundwater comes into contact with either magma or hot rock, hydrovolcanic explosions of steam and rock can occur. Such events, in addition to possibly triggering collapse, can themselves be hazardous (Gardner et al. 1995, Scott et al. 2000).

5.13.2. Effects of Past Volcanic Events

Mount Baker is an active volcano, and one of the youngest in the Cascade Range. Volcanic eruptions in the Mount Baker area began more than one million years ago, and many of the earliest deposits have been removed by glacial erosion. The most recent significant activity from the volcano was in 1843, at a time when permanent populations around its base were few and extensive development of structures had not yet occurred. Table 5.20 describes the past volcanic events at Mount Baker (Gardner et al. 1995, Scott et al. 2000, WEMD 2001).

The last event that directly affected the area of the Reservation to a significant degree occurred approximately 6,600 years ago, when the largest flank collapse in the post-glacial history of the volcano occurred. A lahar was produced that was over 300 feet deep in the upper reaches of the Middle Fork Nooksack River. This lahar was at least 25 feet deep 30 miles downstream from the volcano and probably reached Bellingham Bay. The initial flank collapse was followed by a huge hydrovolcanic explosion that triggered a second collapse and lahar that traveled at least 20 miles. An eruption cloud deposited several inches of ash as far as 20 miles downwind (Scott et al. 2000).

Table 5.20 Past Volcanic Events at Mount Baker¹

Specific Year or Years Ago	Description
1975 - Present	Increased steam and gas emission from Sherman Crater; heat flow increased more than tenfold, then gradually declined over two years before stabilizing at a higher level than before 1975
1958	Boulder Glacier mudflow and avalanches
1891	Approximately 20 million cubic yards of rock fell from flank, producing a lahar that flowed more than 6 miles down slope and covered an area of 1 square mile
1843	Large hydrovolcanic eruption and flank collapse in Sherman Crater; widespread tephra and forest fires; ash-clogged rivers killed many salmon; lahar raised natural Baker Lake at least ten feet
100 - 300	Boulder Creek mudflow and tephra; Rainbow Creek avalanche
300 - 6,000	Tephra and Middle Fork Nooksack River and Park Creek mudflow
6,000 - 10,350	Pyroclastic and lahar flows and Tephra; tephra eruption produced ash layer 20 miles to the northeast; Middle Fork Nooksack River mudflow, probably to Bellingham Bay; Boulder Creek lava flows; Sulphur Creek mudflow and lava flow; Park Creek mudflow
10,350 - 15,000	Multiple lava, pyroclastic, and lahar flows and tephra eruptions from summit; Sulfur Creek and other mudflows

¹ Gardner et al. 1995, Scott et al. 2000, WEMD 2001

Although unlikely, Mount Baker is presumably capable of producing an event that would compare to the 1980 Mount St. Helens eruption that killed 57 people and caused extensive and widespread damage. The collapse of Mount St. Helens produced a landslide (the largest in recorded history on Earth) that buried 14 miles of the North Fork Toutle River valley to an average depth of 150 feet. The initial blast cloud accelerated to at least 300 mph and traveled as far as 17 miles northward. Later, hot pyroclastic flows traveled at 50 to 80 mph as far as 5 miles northward. Several lahars poured into river valleys, pulling trees from the banks and destroying roads and bridges along the way. The lahars damaged or destroyed a total of 27 bridges and nearly 200 homes. The largest and most destructive lahar eroded material from both the huge landslide deposit and the channel of the North Fork Toutle River. The lahar increased in size as it traveled downstream, and after 15 hours reached its maximum size in the Cowlitz River about 50 miles downstream from the volcano. Sediment deposition reduced the carrying capacity at flood stage of the Cowlitz River at Castle Rock from 76,000 cubic feet per second (cfs) to less than 15,000 cfs; the channel depth in the Columbia River was reduced from 40 to 14 feet,

stranding 31 ships in upstream ports (Brantley and Myers 2000). Since the Nooksack River flows through the Reservation, a comparable eruption event at Mount Baker would have a substantial impact on the Lummi Nation. The Mount St. Helens eruption also deposited 1.4 billion cubic yards of ash. The downwind depth of ash was ten inches at ten miles (ash and pumice), one inch at 60 miles, and 0.5 inches at 300 miles (Brantley and Myers 2000).

5.13.3. Volcano Vulnerability Assessment

A volcano is considered active if it has erupted in historic time or is seismically or geothermally active. By this definition, Mount Rainier, Mount Baker, Glacier Peak, and Mount St. Helens are active volcanoes in Washington State. Each of these volcanoes exhibits characteristic behaviors, and it is likely that the types, frequencies, and magnitudes of past volcanic activity will be repeated in the future. In the case of Mount Baker, this suggests that another Nooksack River lahar capable of causing damage on the Reservation from flooding and sedimentation is probable (Gardner et al. 1995, WEMD 2004). The potential effects of a large lahar on the Reservation will be similar to that of a large Nooksack River flood (see Section 5.4.1.1 for details). The Floodplain assessment area is vulnerable to inundation, sedimentation, and damage to structures. Ground transportation to the Lummi Peninsula and Gooseberry Point could be cut off, leaving the peninsula isolated until the roads are cleared. The Sandy Point Peninsula and Northwest Upland areas would face the inconvenience of detour routes and the associated increase in emergency response time. In contrast, the level of sedimentation from a lahar would be much greater than that from a flood. Such sedimentation would reduce the capacity of the river; impact salmon populations; alter the delta, Bellingham Bay, and shellfish beds in Portage Bay; impact and change the location of cultural resources; and potentially change the course of the Nooksack River, even redirecting it into the Fraser River in Canada via the Sumas River drainage. The latter event would have dramatic effects on the entire region. Figure 5.24 shows regional volcanic hazards that may result from an eruption of Mount Baker (USGS 2000).

Areas downwind of a volcanic eruption are also vulnerable to reduced visibility, ash fall, and caustic gases. Ash falls are harsh, acidic, gritty, smelly, and cause lung damage, particularly to the young, the elderly, and those suffering from respiratory problems. When atmospheric sulfur dioxide combines with water it forms diluted sulfuric acid that causes burns to the skin, eyes, mucous membranes, nose, and throat. Acid rains affect water supplies, strip and burn foliage, strip paint, corrode machinery, and dissolve fabric. Heavy ash falls blot out light and interfere with airplane operation. Heavy demand for electric light and air conditioning can cause a drain on power supplies. Ash also clogs waterways and machinery, causes electrical short circuits, and drifts into roadways, railways, and runways. Very fine ash is harmful to mechanical and electronic equipment. The weight of ash can cause structural collapse, particularly when ash becomes saturated with water. Because it is carried by winds, ash continues to present a hazard to machinery and transportation systems for months following an eruption (WEMD 2001). Although the prevailing winds on the Reservation are westerly, occasional weather patterns blow from the east and would expose the Reservation to ash fall (Gardner et al. 1995). A potential ash fall could equally affect all six assessment areas of the Reservation.

Volcanoes usually exhibit warning signs before erupting that can be detected by instruments or observations. However, explosions caused by heated material encountering groundwater can happen without warning. Since Mount Baker is monitored closely by the Cascades Volcano

Observatory, it is likely that the public will be warned before a potential eruption occurs. Such a warning would allow the preparation and implementation of measures that may reduce the impacts of an eruption (Gardner et al. 1995).

Overall, the vulnerability of the Reservation to a Mount Baker eruption ranges from low to high, depending on the area. However, the probability of a large, damaging eruption is very low since these types of eruptions usually occur thousands of years apart. Figure 5.25 shows the estimated relative volcano vulnerabilities on Reservation. Areas affected only by road detours and/or ash fall (i.e., Sandy Point Peninsula, Northwest Upland, and Portage Island) were assigned a low volcano vulnerability. Areas affected by isolation because of road closures (i.e., Lummi Peninsula and Gooseberry Point) and by ash fall were assigned moderate vulnerability.

5.13.4. Potential Volcano Losses

The potential losses to structures on the Reservation are essentially the same as for a Nooksack River flood. As with a large flood, residents and businesses on the Reservation would be impacted economically by the closure of offices and businesses, fewer customers, regional economic losses, and the cost of recovery; details can be found in Section 5.4.1.1, which describes the details of potential losses from a Nooksack River flood. In addition, sedimentation in the Nooksack River and Portage Bay from a potential lahar would cause significant and sustained losses for tribal harvesters of salmon and shellfish. The impacts on salmon populations in the Nooksack River could be long-term if spawning and rearing habitats are buried under large volumes of sediment. Impacts on shellfish populations in Portage Bay are less likely than salmon impacts in the Nooksack River, but could also be long-term.

Ash fall on the Reservation would result in some damage to the painted surfaces of buildings and vehicles and potential damage to mechanical and electrical systems. The effects of ash would present a threat to public health and safety, particularly for vulnerable populations and those with respiratory problems.

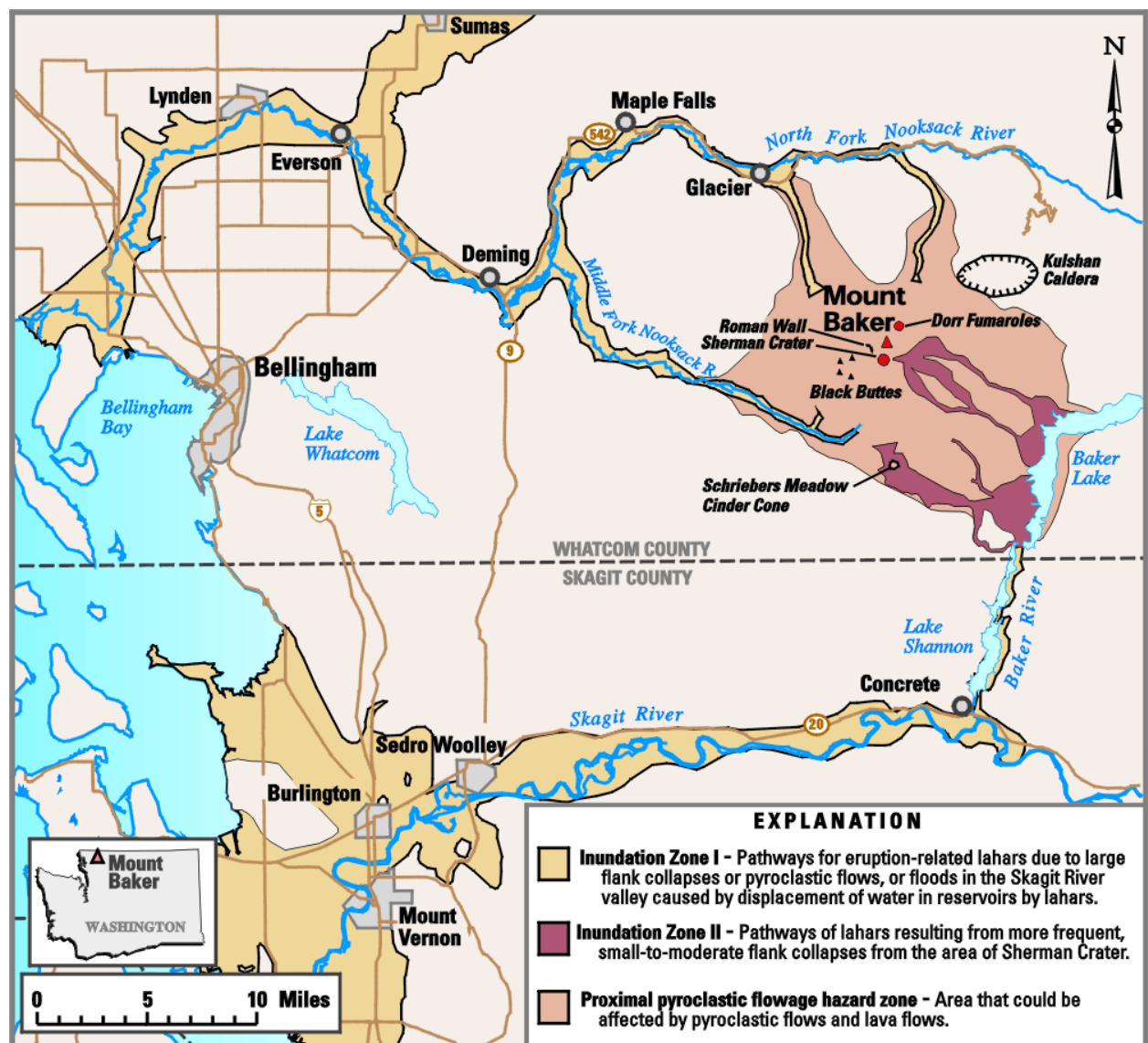
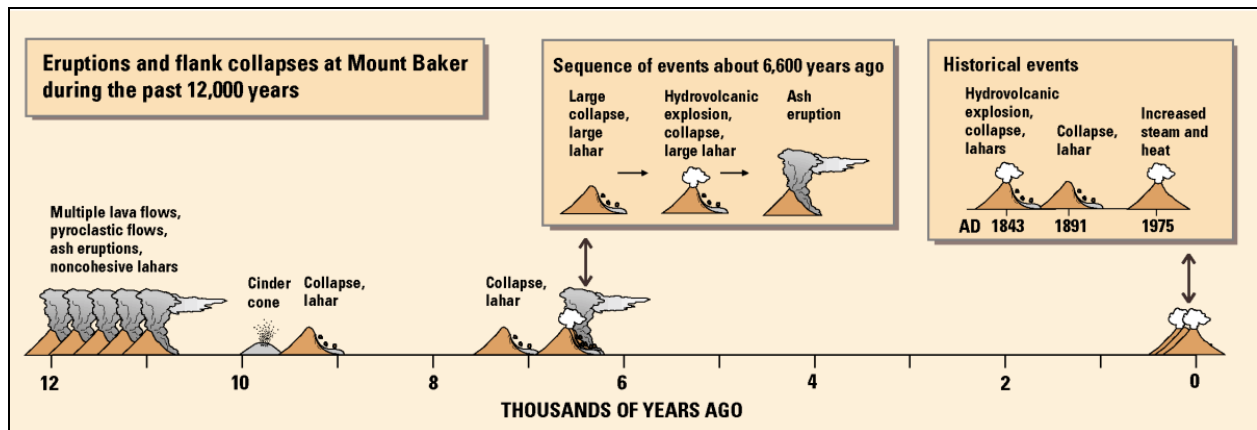


Figure 5.24 Mount Baker Eruption History and Regional Volcanic Hazards (USGS 2000)

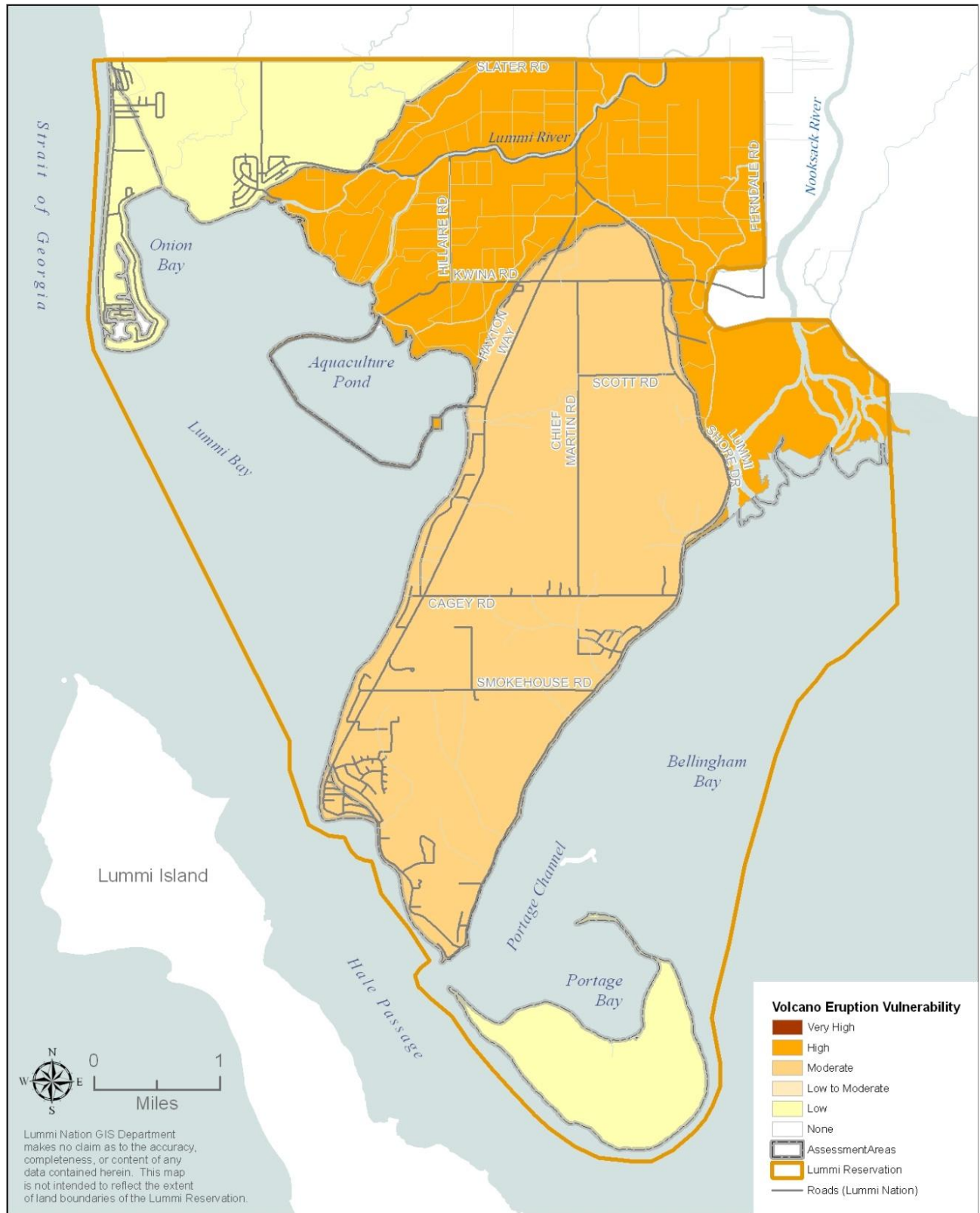


Figure 5.25 Estimated Volcano Vulnerabilities in Reservation Areas

5.14. Tornado

A small tornado occurred in 2004 in Whatcom County. Subsequently, tornadoes were added to the Lummi Nation Multi-Hazard Mitigation Plan during the 2007 update. In this section, past tornado events, tornado vulnerability, and potential tornado losses on the Reservation are described.

5.14.1. Profiles of Tornado Hazards

A tornado is “a violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud” (AMS 2000). To be classified as a tornado, the rotating air or vortex must be in contact with the ground and the cloud base. Tornadoes develop from severe thunderstorms in warm, moist, unstable air along or ahead of cold fronts and are often accompanied by thunderstorms, hail, strong non-tornadic winds, lightning, and flash floods. Although tornadoes generally occur in the spring and summer and between 3:00 pm and 9:00 pm, they can happen at any time of the year and day. Tornadoes are measured by the Fujita scale (F-scale) which ranks the storms from F0 to F5 and relates the degree of damage to the intensity of the wind. The original F-scale was replaced on February 1, 2007 by the Enhanced F-scale which accounts for different degrees of damage to different types of structures (Edwards 2006). Because all prior tornadoes, including those discussed in this section, have been classified according to the original F-scale, it is included here as Table 5.21.

Table 5.21 Fujita Tornado Damage Scale¹

Scale	Wind Speed (mph)	Typical Damage
F0	<73	Light damage: Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged
F1	73-112	Moderate damage: Peels surface off roofs; mobile homes pushed off foundations or overturned; moving automobiles blown off roads
F2	113-157	Considerable damage: Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground
F3	158-206	Severe damage: Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown
F4	207-260	Devastating damage: Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated
F5	261-318	Incredible damage: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 330 feet; trees debarked; incredible phenomena will occur

¹Edwards 2006

5.14.2. Effects of Past Tornado Events

Tornadoes were not included in the 2004 Multi-Hazard Mitigation Plan because there were no tornado occurrences previously recorded for Whatcom County (Pizzillo, 2004) and the Reservation is not located within a Design Wind Speed Zone on FEMA's Wind Zone map. However, an F-0 tornado occurred in Whatcom County on April 27, 2004 causing a small amount of damage and raising awareness that tornadoes can and do occur in western Washington. The 2004 tornado hit a barn located east of Sumas and damaged the barn's metal roofing. The tornado had wind speeds of 70 mph, traveled over 2.7 miles across farmland, and caused an estimated \$10,000 in property damage. At one point, the base of the tornado was determined to be 300 feet wide (Pizzillo 2004). Although no other tornadoes have been recorded for Whatcom County, in 1997 a waterspout was observed on Bellingham Bay and a funnel cloud was observed within a thunderstorm near the towns of Lynden and Blaine (NCDC 2006).

One to two tornadoes are reported in western Washington State each year, although most of these are of low velocity and cause little damage (Pizzillo 2004). There have been three larger tornado events recorded throughout Washington State. The State's deadliest tornado outbreak occurred on April 5, 1972 when two F-3 tornadoes touched down in Vancouver, Washington and west of Spokane, Washington and an F-2 struck rural Stevens County. The storms caused \$50 million in damage, 6 deaths, and 300 injuries (NWS 2006). On May 31, 1997, a record of six tornadoes touched down in Washington in one day with four F-1 tornadoes hitting Stevens and Spokane counties and two F-0 tornadoes in western Washington near Vancouver and Tacoma. These six storms contributed to a record year of 14 tornadoes throughout the State in 1997 which replaced the previous record of four tornadoes in one year in 1989 (NWS 2006). Table 5.22 summarizes these past tornado events.

Table 5.22 Past Tornado Events in Whatcom County and Washington State¹

Year	Description of Event
June 16, 2006	F-0 tornado in Snohomish County
May 18, 2005	F-1 tornado in Snohomish County
June 5, 2004	F-0 tornado in Snohomish County
April 27, 2004	F-0 tornado in Whatcom County just east of the town of Sumas; winds speeds of 70 mph, traveled over 2.7 miles, 300 foot wide base
June 11, 2001	F-0 tornado in King County
October 7, 1997	A brief waterspout was observed at 6:40 am in Bellingham Bay
June 21, 1997	Thunderstorms were reported in the Lynden and Blaine areas in Whatcom County throughout the day and one thunderstorm reportedly contained a funnel cloud
May 31, 1997	Six tornadoes in Washington State in one day; four F-1 storms in Stevens and Spokane counties and two F-0 tornadoes in Vancouver and Tacoma; new record of 14 tornadoes occurred in 1997
1989	Former record of four tornadoes throughout in Washington State in 1989
April 5, 1972	Three tornadoes in Washington State; F-3 in Vancouver, F-3 near Spokane, and F-2 in Stevens County; 6 deaths, 300 injuries, and \$50 million in damage

¹NCDC 2006, NWS 2006, Pizzillo 2004

5.14.3. Tornado Vulnerability Assessment

Every state is at some risk to tornado hazards (FEMA 2006) and tornadoes have been found to occur historically throughout Washington State. Although tornadoes are infrequent in Washington, with an average of two tornados per year compared to the highest annual average in the United States of 139 in Texas (NCDC 2005), it is likely that the types, frequencies, and magnitudes of past events will be repeated in the future. Similar to severe winter storms and windstorms, tornadoes can cause damage from disrupting electric power and telephone systems, interrupting transportation, threatening lives and property, and damaging forests.

Because the four necessary elements of a tornado (i.e., moisture, instability, lift, and wind shear) could occur in any of the six assessment areas of the Reservation, the areas have an equal probability of moderate tornado damage. However, because of the differences in development in these areas, the vulnerability varies. The hazard of direct damage to structures, such as damaged roofs, should be similar in the six assessment areas, with total damages proportional to the number of structures. Areas of denser development, such as Gooseberry Point, Sandy Point Heights, and the Sandy Point Peninsula, may face a greater hazard from fallen power lines relative to less developed areas. Many of the buildings in the Lummi Peninsula and Northwest Upland areas are close to trees that could be blown onto the buildings, an obvious hazard to personal safety and structures. Roads in these two areas are also more likely to be blocked by fallen trees. Because the location of tornado damage is unpredictable, cultural resources in all assessment areas could sustain damage caused by a tornado. Cultural resources that are forest-based or are located in forested areas are especially vulnerable.

5.14.4. Potential Tornado Losses

The potential losses to structures on the Reservation from a tornado are similar to those estimated for direct windstorm losses (not including windstorm losses from coastal flood damage). The damages due to direct tornado effects are estimate as 50 percent destruction of 5 percent of all buildings and destruction of roofs on an additional 5 percent of buildings (requiring roof replacement). Average estimated costs for replacement of the damaged structures were used to calculate total estimated damage costs. The costs of other losses, such as downed utility lines, loss of power, economic and governmental disruption, electrocution, and danger of fire, are difficult to accurately estimate and are not included in the estimated potential losses. Table 5.23 lists the number of structures vulnerable to tornadoes in the five developed assessment areas and the estimated potential losses.

Table 5.23 Vulnerability and Potential Losses of Structures to Tornadoes

Assessment Area	Estimated Vulnerability	Number of Structures	Structure Losses ¹	Roof Losses ²	Location/Comment
Lummi Peninsula	Moderate	1,271	\$7,203,692	\$158,875	▪ Mostly forested
Floodplain	Moderate	61	\$1,794,623	\$7,625	▪ Mostly unforested
Northwest Upland	Moderate	423	\$769,108	\$52,875	▪ Dense development in Sandy Point Heights
Portage Island	Moderate	0	n/a	n/a	▪ No structures
Sandy Point Peninsula	Moderate	500	\$1,916,353	\$62,500	▪ Mostly unforested ▪ Dense development
Gooseberry Point	Moderate	131	\$586,567	\$16,375	▪ Dense development
Total		2,386	\$12,270,342	\$298,250	▪ Total Tornado Losses: \$12,568,592

¹Potential structure losses are estimated as 50 percent of total structure for 5 percent of structures

²Potential roof losses are estimated as the replacement cost of the roof (\$2,500) for 5 percent of structures

5.15. Hazard Risk Assessment and Climate Change

The anticipated impacts of global climate change on the Reservation are significant and diverse. Changes in climate affect not only air temperatures (i.e., global warming), but also sea surface temperatures, precipitation patterns, sea level, storm events, and other physical systems. The best available science indicates that climate change impacts on the Reservation over the coming decades-to-centuries are likely to include increasing surface temperature, changes in precipitation (i.e., wetter winters, drier summers), changes in the seasonality and magnitude of streamflow (i.e., higher winter flows, earlier spring snowmelt, lower summer flows), increasing extent, frequency, and/or intensity of extreme weather events (e.g., heat waves, drought, flooding, wildfire), and changes in the coastal ocean (i.e., increasing sea surface temperature, sea level rise, ocean acidification). Accordingly, there is a high level of confidence that several of the natural hazards that occur on the Reservation are likely to be exacerbated by climate change; these hazards include riverine and coastal floods, coastal erosion, drought, wildfires, and landslides. The potential regional impacts of climate change to winter storms, windstorms, and tornadoes are poorly understood, but may be possible. Conversely, climate change will not impact the incidence of earthquakes, tsunamis, or volcanic activity.

A brief summary of climate change impacts relevant to this MHMP is provided here. More detailed information is available in the Assessment of Climate Change Impacts on the Lummi Indian Nation (LWRD 2015), which evaluates the potential impacts of anthropogenic climate change on the Reservation, Lummi Usual and Accustomed Grounds and Stations (U&A), and Lummi Traditional Territories and presents both mitigation strategies that may reduce the causes of climate change and adaptation strategies that may minimize climate change impacts that cannot be avoided. Anticipated climate change impacts on the Reservation include, but are not limited to:

- Riverine floods** – With warmer, wetter winters anticipated in the Pacific Northwest under future climate scenarios, there will be significant impacts to hydrology. For example, as more precipitation occurs during the winter and this precipitation occurs as rain rather than snow, there will be changes in the seasonality and magnitude of streamflow. The Nooksack River is currently considered a transitional or mixed rain-snow watershed, as compared to a rainfall dominant or snowmelt dominant watershed. This is evident in the bimodal trend in monthly stream discharge, where two distinct peaks in streamflow are observed each year. The first peak (November – January) coincides with runoff from fall/winter storm events, while the second peak (March – May) coincides with spring snowmelt discharged to the Nooksack River’s headwaters in the Cascades. Over time, reductions in spring snowpack, earlier snowmelt, and increased winter rainfall are expected to shift transitional hydrologic regimes toward rainfall dominated hydrologic regimes characterized by a “single-peak” hydrograph. In the Nooksack River, this shift is projected to increase winter discharge, decrease summer discharge, and shift the timing of spring peak melt earlier. These hydrologic alterations will increase winter flows in the Nooksack River, as well as the frequency and magnitude of winter flood events. Results from a hydrologic model simulating future streamflow in the Nooksack River suggest that the magnitude of a historical 10-year flood will have a return interval of 3 years by 2050 (Dickerson-Lange et al. 2013). Similarly, Mantua et al. (2010) report that a historical 20-year flood event on the Nooksack River may occur up to 30 percent more frequently by mid-century.
- Coastal floods** – Warmer global temperatures have accelerated the rate of global sea level rise (i.e., eustatic sea level rise), due to the combined effects of increased land ice melt and thermal expansion of the world’s oceans, which both contribute to increased ocean volume. Throughout the 20th century, sea level rose at a rate of approximately 1.7 mm/yr, but in recent decades (1993-2010) has accelerated to approximately 3.2 mm/yr (IPCC 2013) or nearly double the rate of the earlier period. Continued acceleration of the rate of sea level rise is expected. Based on recent Intergovernmental Panel on Climate Change (IPCC) estimates, global mean sea level by 2100 (relative to the 1986-2005 period) is projected to increase from approximately 1.3 ft under the “very low” emissions scenario to approximately 2.1 ft under the “high” emissions scenario (IPCC 2013). A wider range and generally higher estimates of regional sea level rise are reported by the National Research Council, whose research suggests that mean sea level along the outer coasts of Washington, Oregon, and California may increase between 0.3 and 4.7 ft by 2100 (NRC 2012). Additionally, regional differences in vertical land movement (e.g., tectonic uplift or subsidence) and surface sediment dynamics (e.g., sediment accretion, shallow subsidence, and erosion) are expected to generate regional variability in realized sea level change. As sea levels rise, Reservation shorelines and adjacent low-lying areas will become increasingly vulnerable to permanent inundation or inundation during high tide and more frequent and intense coastal flooding (from storm surge) and river flooding (from the “backwater effect”).
- Coastal erosion** – Concurrent with inundation and coastal flooding, sea level rise will also accelerate bluff and beach erosion. Although erosion is an important natural process that allows shorelines, which are not fixed physical features, to migrate over time, erosion management may be necessary where accelerated erosion threatens to destabilize important infrastructure.

- **Drought** – Another serious consequence of global climate change is observed and expected future increases in the extent, frequency, and/or intensity of extreme weather events, including drought. In the Pacific Northwest, climate change impacts include significant changes in the seasonality of precipitation (drier summers and wetter winters), which is expected to increase the incidence and intensity of drought events.
- **Wildfires** – In the Pacific Northwest, warmer and drier summers as a result of climate change are expected to decrease fuel moisture, while warmer and wetter winters are expected to promote vegetation growth and consequently increase fuel availability. With more abundant and highly flammable fuels, an increasing annual wildfire burn area is anticipated. Although it is difficult to forecast future wildfire activity, the results of one model simulating the response of wildfire in forests west of the Cascade Mountains under a high greenhouse gas emissions scenario suggest that the area burned annually may increase by 150 to 1,000 percent by the 2080s when compared to the 1970-2000 average (Rogers et al. 2011). It should be noted that because of the low annual area burned in west-side forests, the statistical relationships between climate and fire have a high level of uncertainty and less explanatory power compared to east-side models where frequent fire activity provides sufficient data to build predictive relationships. Regardless, significant consequences will result from changes in wildfire activity.
- **Landslides** – Climate change may increase the risk of landslides by affecting several of the factors that influence slope stability (e.g., precipitation, soil moisture, erosion, vegetation coverage). Although most of the Reservation is at no or minimal risk of slope failure, there are some areas, particularly along coastal bluffs, that are at significant risk of damage due to landslides. In areas where past landslides occurred along the Lummi Peninsula shoreline (e.g., Lummi Shore Road, West Beach), wave-caused erosion along the base of the bluff, saturated soils from periods of heavy or prolonged rainfall, and/or poor storm water drainage associated with development at the top of the bluff contributed to slope failure. Bluff erosion was previously discussed in the context of sea level rise impacts on coastal erosion, but it also bears mention that climate change induced variations in precipitation patterns (i.e., wetter winters, increasing frequency of heavy rainfall events) are also likely to increase landslide risk in already vulnerable areas of the Reservation.

In conclusion, the potential impacts of global climate change are likely to increase the vulnerability of the Reservation to several natural hazards, including riverine floods, coastal floods, coastal erosion, drought, wildfires, and landslides. Estimated vulnerabilities of the natural, social, and built systems of the Reservation to climate change are provided in the aforementioned climate change impact assessment (LWRD 2015); monetary damage estimates as a result of climate change impacts have not yet been developed.

5.16. Risk Assessment Summary

Table 5.24 lists the six assessment areas and primary facilities on the Reservation, the hazards that potentially threaten them, the estimated relative vulnerability to the hazard, and the estimated relative probability or frequency of damage from a hazard event occurring. The estimated vulnerability represents an overall rating for the hazard sites within each of the Reservation areas. In these ratings, consideration was given to the vulnerability of an area

relative to other areas, both on- and off-Reservation. Many of the hazards pose a threat to an entire area; these threats may vary across an area (e.g., wildfire), may be largely uniform across an area (e.g., earthquake, winter storm, or drought), or may vary in some areas and be uniform in other areas (e.g., flood). Other hazards pose site-specific threats (e.g., landslides and coastal erosion) and the vulnerability rating for an area is based on the hazard sites in the area rather than the whole area. That is, although there is a generally low to moderate vulnerability in the landslide-prone areas of the Lummi Peninsula, there is also a high vulnerability in a few specific locations, while the remainder of the Lummi Peninsula is not vulnerable to landslide.

Figure 5.26 depicts the combined, estimated, multi-hazard vulnerability of the six assessment areas on the Reservation for all of the assessed hazards except drought, coastal erosion, and tornado. Drought and tornado vulnerability were considered equal for the whole Reservation and were not mapped; relative coastal erosion vulnerabilities were not mapped on the uplands and therefore did not overlap with the mapping of the other hazards. The combined vulnerability for the eight natural hazards mapped on the upland areas was determined using GIS by assigning values of zero to five to the qualitative vulnerability levels of none, low, low to moderate, moderate, high, and very high, respectively. These values were summed for each point on the map and the overall vulnerability levels assigned to the appropriate ranges of summed values. The overall vulnerability levels reflect the relative vulnerability between areas on the Reservation. Table 5.1 lists the number and value of critical and other public facilities, commercial facilities owned by the Lummi Nation, and residences in the six assessment areas of the Reservation.

Table 5.24 Summary of Hazard Vulnerability and Probability on the Reservation¹

Assessment Areas and Critical Facilities	Flood	Earthquake	Winter Storm	Windstorm	Coastal Erosion	Drought	Wildfire	Landslide	Tsunami	Volcano	Tornado
Lummi Peninsula Assessment Area	V/V ²	V/V	V/V	V	V/V	V	V	V/V	V/V ²	V ²	V
	P	P	P	P	P	P/P	P/P	P/P	P	P	P
Tribal Administration Building, LIBC Campuses, Tribal Health Clinic, Lummi Early Learning Programs, Northwest Indian College, Kwina Road Wastewater Treatment Plant	V/V ²	V	V	V	—	V/V	V	—	V/V ²	V ²	V
	P	P	P	P	—	P/P	P/P	—	P	P	P
Lummi Nation School, Lummi Youth Academy, Wex'li'em	V/V ²	V/V	V	V	—	V	V	—	V/V ²	V ²	V
	P	P	P	P	—	P/P	P/P	—	P	P	P
Little Bear Creek Elders Home	V/V ²	V/V	V	V	—	V	V	—	V/V ²	V ²	V
	P	P	P	P	—	P/P	P/P	—	P	P	P
Gooseberry Point Fire Station	V/V ²	V/V	V	V	—	V	V	—	V/V ²	V ²	V
	P	P	P	P	—	P/P	P/P	—	P	P	P
Gooseberry Point Wastewater Treatment Plant	V/V ²	V/V	V	V	—	V	V	V/V	V/V ²	V ²	V
	P	P	P	P	—	P/P	P/P	P/P	P	P	P
Floodplain Assessment Area	V	V	V	V/V	V	V	V	—	V	V	V
	P	P	P	P	P	P/P	P	—	P	P	P
Silver Reef Hotel, Casino & Spa, Lummi Mini-Mart	V	V	V	V/V	—	V/V	V	—	V	V	V
	P	P	P	P	—	P	P	—	P	P	P
Northwest Upland Assessment Area	V ²	V	V/V	V	V/V	V	V	V/V	V ²	V ²	V
	P	P	P	P	P	P/P	P/P	P/P	P	P	P
Sandy Point Heights Fire Station	V ²	V	V	V	—	V	V	V	V ²	V ²	V
	P	P	P	P	—	P/P	P/P	P/P	P	P	P
Sandy Point Peninsula Assessment Area	V/V	V	V	V/V	V/V	V	V/V	—	V	V	V
	P	P	P	P	P	P/P	P	—	P	P	P
Sandy Point Fire Station	V	V	V	V	V	V	V	—	V	V	V
	P	P	P	P	P	P/P	P	—	P	P	P
Sandy Point Wastewater Treatment Plant	V	V	V	V	—	V	V	—	V	V	V
	P	P	P	P	—	P/P	P	—	P	P	P
Portage Island Assessment Area	V/V	V/V	V/V	V	V/V	V	V	V/V	V/V	V	V
	P	P	P	P	P	P/P	P/P	P/P	P	P	P
Gooseberry Point Assessment Area	V/V ²	V	V	V/V	V/V	V	V	—	V/V ²	V ²	V
	P	P	P	P	P	P/P	P	—	P	P	P

Table 5.24 Summary of Hazard Vulnerability and Probability on the Reservation¹

Assessment Areas and Critical Facilities	Flood	Earthquake	Winter Storm	Windstorm	Coastal Erosion	Drought	Wildfire	Landslide	Tsunami	Volcano	Tornado
LIBC Fish Buying Station and Pier, LCC Dock, Repair Shop, and Boat Storage, Fisherman's Cove Mini-Mart, Whatcom County Ferry Terminal	V/V ²	V	V	V	V	V	V	—	V/V ²	V ²	V
	P	P	P	P	P	P/ P	P	—	P	P	P

¹Vulnerability: **V** =High, **V**=Moderate, V= Low; Probability: **P**= High, **P**= Moderate, P=Low, — = not applicable

²Northwest Upland is affected but not isolated by flood road closures; facilities on the Lummi Peninsula are isolated and therefore merit a higher vulnerability to flood, lahar, and tsunami

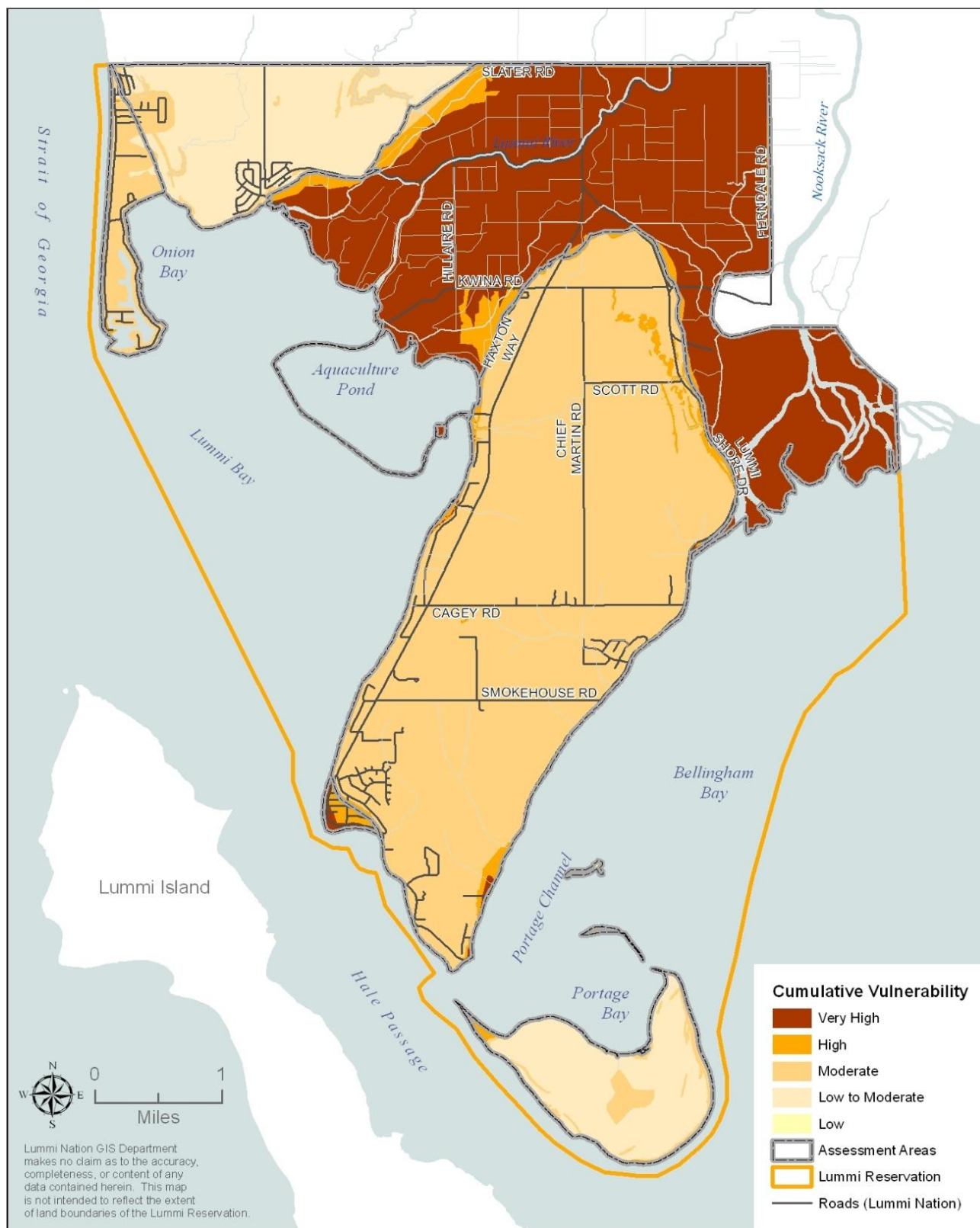


Figure 5.26 Combined Relative Multi-Hazard Vulnerability on the Reservation

6. MITIGATION STRATEGY

6.1. Hazard Mitigation Goals and Objectives

The following goals and objectives were adapted from the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a). As part of the 2007 plan update, the goals and objectives were reviewed by the Multi-Hazard Mitigation Team (MHMT) on January 25, 2007 and by members of the Natural Resources, Planning, and Cultural Commissions on February 28, 2007 and determined to still be valid. Based on the comments from these meetings, the goals and objectives of the Lummi Nation Spill Prevention and Response Plan were considered to ensure that they are incorporated within this plan's goals and objectives. No changes were made as the spill plan's goal to minimize the adverse effects of oil and hazardous materials spills through prevention, preparedness, and response is consistent with the mitigation strategy. During the 2010 and 2015 updates, the goals and objectives were again confirmed by the MHMT during meetings on May 4, 2010 and August 20, 2015, respectively.

The goals of the Lummi Nation Multi-Hazard Mitigation Plan (MHMP) are:

1. Reduce the threats to public health and safety posed by natural hazards;
2. Reduce the structural damages caused by natural hazards;
3. Reduce the environmental impacts of natural hazards, mitigation actions, and future development activities including impacts to cultural properties; and
4. Reduce the long-term costs resulting from natural hazards and their mitigation.

The objectives of the Lummi Nation MHMP are listed below. Actions that have been taken to implement each objective have been listed as part of the plan updates.

1. Discourage new development in areas that are vulnerable to hazards or ensure that development occurs in such a way that risk is minimized.
⇒ This objective has been addressed through the continued application of Lummi Nation Code of Laws (LCL) Title 15 (Land Use, Zoning, and Development Code), LCL Title 15A (Flood Damage Prevention Code), and LCL Title 22 (Building Code).
2. Protect or alter existing development in hazardous areas to make it less susceptible to damage.
⇒ This objective has been addressed through the Marine Drive Elevation project, Slater Road Elevation Pre-Disaster Mitigation project (not implemented yet due to budget constraints), the alteration of two existing floodplain residential developments to better comply with the National Flood Insurance Program (NFIP), the acquisition and relocation of homes in flood-prone areas, and a project (still in progress) to post 9-1-1 address signs at residences throughout the Reservation.
3. Ensure that the solution chosen to protect existing development is the most cost-effective available; protects or enhances cultural properties, natural resources, and sensitive

terrestrial, riparian, or coastal habitats; and is consistent with applicable land use plans and regulations.

⇒ This objective was addressed during the development and implementation of two Pre-Disaster Mitigation projects. Both projects were determined to have a benefit-cost ratio greater than 1.0 through a benefit-cost analysis, underwent environmental and cultural resource reviews, and have followed the applicable tribal, county, state, and federal permitting procedures.

4. Ensure that the benefits of maintaining existing facilities outweigh their costs; if not, redesign facilities to make them less susceptible to damage or implement some other type of solution at the site.

⇒ The tribal facility at Gooseberry Point, which most recently housed the tribal Employment Training Center (ETC) was condemned and has been demolished.

5. Redesign existing projects and/or change maintenance practices to protect or enhance riparian or coastal habitats.

6. Manage floodplains, rivers, streams, and other water resources for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, finfish and shellfish harvesting, open space, recreation, water supply, cultural/traditional practices, and hydropower.

⇒ This objective has been addressed, in part, through improvements to the Lummi Nation's participation in the National Flood Insurance Program (NFIP) by three Community Assistance Visits (CAVs) from FEMA and through the Environmental Protection Agency's approval of the Lummi Nation's application to administer the water quality standards program of the federal Clean Water Act. Both Pre-Disaster Mitigation projects and the Marine Drive Elevation project (part of the Smuggler's Slough Restoration project) will reduce flooding hazards, restore areas of the floodplain, and improve habitat. In addition, the tribal land use permitting system (LCL Title 15) ensures that Reservation development is aligned with tribal goals.

7. Improve coordination and consistency between the Lummi Nation and other jurisdictions, as appropriate, in management activities for floodplain and coastal areas.

⇒ This objective has been implemented, in part, through efforts to coordinate with Whatcom County and Washington State for the purchase and installation of tsunami warning systems and the development of tsunami evacuation routes and brochures. In addition, the Lummi Nation has worked with FEMA to coordinate and resolve findings and/or recommendations from three Community Assistance Visits (CAVs) and to develop the 2013 Coastal Flood Study (RiskMAP) Partnership Agreement.

8. Increase public awareness of natural hazards and improve appropriate preparation for and response to such hazards.

⇒ This objective is being addressed through the work of the Multi-Hazard Mitigation Team, articles in the Lummi monthly newspaper (Squol Quol), development of tsunami evacuation route maps and brochures, annual mailings to floodplain

residents, installation and weekly testing of the All-Hazard Alert Broadcast (AHAB) towers, installation of tsunami evacuation signs, and sharing of this plan and associated grant applications with other tribes. Additional public outreach efforts include a Hazard Fair hosted by the Lummi Natural Resources Department (LNR) the Northwest Indian College and two Thursday Safe Streets Walks (2011 Hazard Walk, 2013 Community Disaster Preparedness Walk) hosted by LNR and the Lummi Nation Police Department.

9. Improve hazard warning and emergency response systems.

⇒ This objective has been implemented through the adoption of and subsequent update to the Lummi Nation Comprehensive Emergency Management Plan, development of the LIBC Emergency Notification Text Messaging System, application and award of a grant for turn-key installation of two tsunami warning systems, development of tsunami brochures, and installation of tsunami evacuation signs.

6.2. Mitigation Measures

Threats to public health and safety from natural hazards are significant on the Reservation. Structural mitigation measures, especially those proposed in this MHMP, are important for addressing public safety hazards. Public education measures that improve preparation for and response to natural hazards may be equally important, or in many cases, more important than structural measures.

With many areas of the Reservation vulnerable to multiple natural hazards, there is a cumulative effect on overall potential losses. For example, coastal erosion damages properties, increases the probability of landslides in bluff areas, and increases the probability of flooding in low-lying areas. Where there is a cumulative effect on potential losses, there will also be a cumulative effect on the benefits derived from mitigation actions. For example, development regulations or property acquisitions that prevent new structures from being built or remove existing structures from hazard areas will avoid the damages associated with all of the hazards that uniquely affect the property. Likewise, the establishment of home emergency kits and improved emergency response capabilities will benefit residents during all hazard events. It is important to consider both cumulative impacts and cumulative benefits when assessing mitigation measures.

Achieving the objective of becoming a disaster-resistant community will require significant investment of financial resources that the Lummi Nation does not currently have available due to competing needs (e.g., health care, education). Expensive measures necessary to achieve this objective include relocation or acquisition and removal of many structures that are in highly vulnerable locations, construction of substantial flood protection structures, and possible seismic retrofitting of older structures (replacement of some structures may be more cost effective). Given the high cost of these projects and limited tribal resources, acquiring outside funding for these measures is a high priority action item. In addition to pre-disaster mitigation, recovery from disasters will also present a financial challenge to both the LIBC and individuals. Given the relatively low median income for tribal members, the damages and economic disruption caused by a hazard event will be difficult to recover from without assistance.

The remainder of this section will identify, evaluate, and prioritize the feasible, environmentally sound mitigation actions currently in use or under consideration by the Lummi Nation. An explanation of how each mitigation activity contributes to the overall mitigation strategy for the Lummi Nation, as well as alternative mitigation approaches, if available, are also discussed. Any mitigation action undertaken should have a positive benefit-cost ratio and should meet the applicable goals, objectives, and policies described in this plan. A summary of all mitigation actions and priorities are listed in Table 6.11 at the end of this section.

6.2.1. All Hazards

The following mitigation actions are applicable to all hazards.

6.2.1.1. Current All Hazard Mitigation Actions

Current mitigation actions implemented by the Lummi Nation that apply to all hazards include land use plans and development regulations, emergency management and spill response plans, and coordination with the Whatcom County emergency response agencies. For early warning of impending hazard events, the LIBC relies on communication with the Whatcom County Division of Emergency Management, as well as federal and state agencies. Residents on the Reservation receive hazard warnings from public news outlets and through the LIBC.

Mitigation actions for all hazards that have been undertaken since the adoption of the 2004 MHMP based on the plan's recommendations include:

- The Multi-Hazard Mitigation Team (MHMT) was formed in 2004 pursuant to LIBC Resolution No. 2004-015 and is responsible for overseeing the development, implementation, and monitoring of this plan. The MHMT consists of the Natural Resources Department Executive Director, the Planning and Public Works Department Director, the Chief of the Lummi Nation Police Department, the Cultural Resources Department Director (position appointed in 2010 pursuant to LIBC Resolution No. 2010-093), the LIBC Safety Officer, and assigned staff from the Natural Resources, Planning and Public Works, and Cultural Resources departments. The MHMT met five times between 2005 and 2007 to discuss and review progress on mitigation projects, review the Lummi Nation Comprehensive Emergency Management Plan (CEMP) and the Lummi Nation Spill Prevention and Response Plan, and discuss the MHMP update. The MHMT met four times between 2007 and June 2010 to discuss and review progress on mitigation projects. In addition, there were approximately 10 MHMT meetings that specifically addressed the Slater Road Elevation Project implementation. Between June 2010 and June 2015, the MHMT met one time to discuss current mitigation projects and identify proposed mitigation actions to pursue in the near-term future. Over this same time period, informal MHMT subcommittees met more than 10 times to discuss the Coastal Flood Study (RiskMAP) Partnership Agreement, the Community Rating System Community Verification Visit, the 9-1-1 addressing project, the CEMP update, and the Whatcom County Floodplains by Design project, as well as participated in the LIBC Safety Committee meetings.
- The Lummi Nation Multi-Hazard Mitigation Plan was posted on the Lummi Nation website (www.lummi-nsn.gov) and the Lummi Natural Resources Department website (<http://lnnr.lummi-nsn.gov/LummiWebsite/Website.php?PageID=72>) and will be

replaced with the adopted and approved 2015 update. The MHMP and associated grant applications have been shared with at least eight tribes including tribes in Massachusetts, Oklahoma, Idaho, Oregon, and Washington.

- The Lummi Nation Comprehensive Emergency Management Plan (CEMP) was adopted in 2006 by LIBC Resolution No. 2006-036. The 2015 update to the CEMP was adopted by LIBC Resolution No. 2015-086.
- The Lummi Nation Spill Prevention and Response Plan was completed in 2005 and is being implemented through spill response preparedness efforts including equipment purchases, deployment (practice and response), and training.
- The Lummi Nation coordinated with Whatcom County and worked closely with Washington State for the purchase and installation of tsunami warning systems, the development of tsunami brochures, and the installation of tsunami evacuation signs. A 2006 Emergency Management Preparedness Assistance Grant (EMPAG) grant was awarded from the Washington State Emergency Management Division for the turn key installation of two All-Hazard Alert Broadcast (AHAB) tsunami warning systems within the modeled tsunami inundation zones on the Reservation.
- A 2005 FEMA Pre-Disaster Mitigation-Competitive (PDM-C) grant was received for a total project cost of \$5,976,843 and a 75 percent federal share of \$4,482,632. The grant included two project subgrants and one management subgrant. The two projects were:
 - Slater Road Elevation Project – This project called for the elevation of an almost 1 mile long, frequently flooded section of Slater Road east of the Nooksack River bridge to above the 100-year flood level. The elevation project was planned to include an approximately 400 foot long bridge that would allow continued access to the Reservation, Lummi Island, and nearby industries during a 100-year flood event. Because the cost estimates for Slater Road Elevation Project exceeded the available funding (shared between the Lummi Nation and Whatcom County), and additional funding sources needed to be identified, the grant reached its 5 year time limit and could not be used for the project. Efforts to secure the needed funding continue.
 - Sandy Point Coastal Acquisition Project – This project included the acquisition and removal of up to three homes from the high velocity coastal flood zone (V Zone) along the Sandy Point Peninsula.
- Staff of the LWRD attended training on the FEMA benefit-cost analysis software in 2004 and used the software to run analyses for their 2005 application for two Pre-Disaster Mitigation-Competitive (PDM-C) projects.
- The establishment of 72-hour emergency kits and family plans was encouraged through articles in the community newspaper and during community outreach events. Targeted outreach events included the following:
 - In June 2009, a Hazard Fair was conducted at the Northwest Indian College where student presentations enhanced public awareness of hazard impacts and preventative measures.
 - In August 2011, the Lummi Natural Resources Department (LNR) and Lummi Nation Police Department (LNPd) co-hosted a Thursday Safe Streets Walk (“Hazard Walk”) with staff available to discuss and provide educational materials

concerning floods (e.g., Flood Insurance Rate Maps [FIRMs], National Flood Insurance Program [NFIP] brochures), tsunamis (e.g., tsunami simulation for the Reservation), LNPd response capabilities (e.g., Incident Command Vehicle), and home preparedness (e.g., 72-hour emergency kits, emergency radios).

- In April 2012, the LIBC Safety Officer and LNPd provided a two hour Lummi Emergency Management Training: Disaster Preparedness for community members.
- In April 2012, the LNPd provided a three day Community Emergency Response Team (CERT) training.
- In September 2013, the LNR and LNPd co-hosted a second Thursday Safe Streets Walks, this time called the “Community Disaster Preparedness Walk.” Education and outreach activities were similar to those provided at the August 2011 event.
- Beginning in 2013, contractors implementing the 9-1-1 addressing project have installed approximately 820 house number signs at tribal member owned homes on the Reservation to date. These signs have white numbers on a blue background and are reflective, helping to improve safety by ensuring that first-responders can quickly locate to the correct house in the event of an emergency. Initial efforts have focused on signage on the Lummi Peninsula; additional funding is needed to expand the addressing project to other areas of the Reservation.
- The LIBC Emergency Notification Text Messaging System was developed in 2014. This system allows the Chairman’s and/or Vice Chairman’s office to send emergency notifications via text message to LIBC directors and key staff who have registered their cell phone number and service provider with administrators. The text system currently serves LIBC officers, the Police, Planning and Public Works, and Natural Resources departments, the Tribal Health Clinic, the Northwest Indian College, and the Lummi Nation School. Expansion of this program to other departments and tribal institutions is planned.
- In 2015, the draft Assessment of Climate Change Impacts on the Lummi Indian Nation was developed by staff of the Lummi Water Resources Division. The purpose of this assessment was to evaluate the potential impacts of anthropogenic climate change on the Reservation, Lummi Usual and Accustomed Grounds and Stations (U&A), and Lummi Traditional Territories and present both mitigation strategies that may reduce the causes of climate change and adaptation strategies that may minimize climate change impacts that cannot be avoided.

6.2.1.2. Proposed All Hazard Mitigation Actions

The following actions are recommended to meet the Lummi Nation’s goals and objectives for mitigation of all hazards. These actions are summarized in Table 6.1; actions are identified as “AH” (an acronym for “all hazard”) followed by a unique identification number. During the 2010 update, former All Hazard Short-Term Action 8 and All Hazard Long-Term Action 3 were combined into one action item (AH7), former Long-Term Flood Mitigation Action 1 became AH14, and AH15 through AH19 were added. All Hazard 18 (AH18) was completed pursuant to LIBC Resolution No. 2010-093, which adopted the 2010 update to the MHMP and appointed the Cultural Resources Department Director as a member of the Multi-Hazard Mitigation Team. As

a result, AH18 was removed from the list of proposed mitigation actions and subsequent mitigation actions were renumbered (i.e., former AH19 became new AH18) during the 2015 update.

Table 6.1 Proposed All Hazard Mitigation Actions

AH1	
Establish the formal goal of becoming a disaster-resistant community, including objectives or benchmarks for preparedness.	
Coordinating Organization:	Multi-Hazard Mitigation Team, Lummi Indian Business Council
Timeline:	Ongoing
Plan Goals Addressed:	All
Funding:	Tribal, External
AH2	
Maintain the established Multi-Hazard Mitigation Team comprised of representatives from pertinent LIBC departments and other organizations on the Reservation.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	All
Funding:	Tribal, External
AH3	
Establish an Emergency Management Division within the Lummi Nation Police Department and hire an Emergency Manager.	
Coordinating Organization:	Lummi Indian Business Council
Timeline:	Ongoing
Plan Goals Addressed:	All
Funding:	Tribal, External
AH4	
To help disseminate the MHMP, expand knowledge of hazard mitigation on the Reservation, and encourage further mitigation actions, maintain the posting of this plan, including updated versions, on the Lummi Nation website, and add links to further hazard mitigation information (e.g., DisasterHelp.gov, FloodSmart.gov) as time and resources permit.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	All
Funding:	Tribal, External
AH5	
Implement, maintain, and update the Lummi Nation Comprehensive Emergency Management Plan (Appendix C).	
Coordinating Organization:	Police Department
Timeline:	Ongoing
Plan Goals Addressed:	Public Health and Safety, Reduce Vulnerability
Funding:	Tribal, External

Table 6.1 Proposed All Hazard Mitigation Actions

AH6	
Continue to implement and maintain the Lummi Nation Spill Prevention and Response Plan through government-wide preparedness (e.g., Incident Command System [ICS] and National Incident Management System [NIMS] training), safety and response training, and coordination with area industries.	
Coordinating Organization:	Natural Resources and Police departments
Timeline:	Ongoing
Plan Goals Addressed:	Public Health and Safety, Reduce Vulnerability and Long-Term Costs
Funding:	Tribal, External
AH7	
Continue to coordinate LIBC emergency response efforts, as appropriate, with those of Whatcom County and other federal, state, and local agencies.	
Coordinating Organization:	Multi-Hazard Mitigation Team, Natural Resources and Police departments
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal
AH8	
Establish 24-hour emergency medical response capability (i.e., an equipped Medic 1 unit along with paramedics and emergency medical technicians) located on the Reservation.	
Coordinating Organization:	Planning and Public Works Department, Police Department
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External
AH9	
Further promote the establishment and maintenance of home survival/emergency kits.	
Coordinating Organization:	Natural Resources, Planning and Public Works, and Police departments
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External
AH10	
Purchase, or make available for purchase, 9-1-1 house number signs for all addressed structures on the Reservation to aid emergency responders.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External
AH11	
Continue to pursue funding for the Lummi Nation mitigation priorities and recommendations described below, including funding for needed staff and infrastructure.	
Coordinating Organization:	Multi-Hazard Mitigation Team, Natural Resources Department
Timeline:	Ongoing
Plan Goals Addressed:	All
Funding:	Tribal, External

Table 6.1 Proposed All Hazard Mitigation Actions

AH12	
Promote a disaster and hazard mitigation fund to assist the mitigation and response efforts of individuals and organizations on the Reservation.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	All
Funding:	Tribal, External
AH13	
Improve and sustain public information and education programs targeted at mitigating natural hazards.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External
AH14	
Develop capability to use HAZUS-Multi-Hazard (MH) software to estimate potential losses and benefit-cost analysis software to analyze possible mitigation options. Develop list of projects prioritized by benefit-cost ratio and their importance to the Lummi Nation and its resources.	
Coordinating Organization:	Natural Resources and Planning and Public Works departments
Timeline:	Ongoing
Plan Goals Addressed:	All
Funding:	Tribal, External
AH15	
Provide Community Emergency Response Team (CERT) training to all residents on the Reservation.	
Coordinating Organization:	Lummi Indian Business Council, Police Department
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External
AH16	
Expand the emergency warning capabilities on the Reservation beyond the All-Hazard Alert Broadcast (AHAB) towers through a geographically-specific alert system that alerts personal devices (e.g., cell phones).	
Coordinating Organization:	Lummi Indian Business Council, Police Department
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External
AH17	
Develop a formal cultural resources protection strategy.	
Coordinating Organization:	Cultural Resources Department
Timeline:	5 years
Plan Goals Addressed:	Reduce Vulnerability (Cultural Resources)
Funding:	Tribal, External

Table 6.1 Proposed All Hazard Mitigation Actions

AH18	
Develop a Post-Disaster Management Plan.	
Coordinating Organization:	Police Department, Planning and Public Works Department
Timeline:	5 years
Plan Goals Addressed:	Public Health and Safety, Reduce Vulnerability and Long-Term Costs
Funding:	Tribal, External

AH1 Disaster-Resistant Community Goals: Establishing benchmarks for preparedness will help maintain focus on the goal of developing a disaster-resistant community. These benchmarks will be used to track progress towards institutionalizing preparedness and hazard mitigation, including the characterization of natural hazards, implementation of ordinances or other standards to mitigate natural hazards, and ongoing education on natural hazard preparedness and mitigation. By measuring or tracking progress toward achieving the benchmarks and being accountable to the LIBC, the chances of success will increase.

AH2 Multi-Hazard Mitigation Team: The Multi-Hazard Mitigation Team plays a major role in hazard mitigation activities, including the monitoring and development of this MHMP. The maintenance of this team is important because it is the only interagency Lummi Nation organization focused on coordination of multi-hazard mitigation. The LIBC resolution (Appendix A) that adopted this updated MHMP authorizes the continuation of the Multi-Hazard Mitigation Team and directs the LIBC General Manager or his designee to coordinate the formation, staffing, and operations of this team and to ensure its effectiveness.

AH3 Lummi Nation Emergency Management Division: The establishment of an Emergency Manager position would benefit almost all proposed mitigation actions that are listed under the different hazards by coordinating the enforcement of regulations that are part of hazard mitigation, advising the Multi-Hazard Mitigation Team, and conducting public outreach and education. The recommended Emergency Management Division would also be responsible for the maintenance and update of this plan, which is currently a responsibility of the Natural Resources Department's (LNR) Water Resources Division (LWRD).

AH4 and AH9 Public Outreach and Education: Many post-disaster reports note the need to strengthen and sustain public information, education, and training efforts by providing additional resources (Oregon 2000a). Although it is commonly recognized that interest in reducing losses increases during and after events, there is an ongoing need to provide residents with hazard mitigation information. Post-disaster assessment reports cite the need to have timely seasonal information available, have better methods to inform residents where they can obtain hazard mitigation information, use improved electronic methods (e.g., websites, social media), and have materials oriented toward the intended users. This helps keep awareness levels higher, will stimulate actions by some, and reminds users to consider and include hazard mitigation measures in the context of regular activities, such as building a new home, relocating an office, or repairing a business. Information has been provided to Reservation residents through the community newspaper (Squol Quol), the Lummi Nation website, the Lummi Natural Resources

Department website, and the Lummi Nation News television program about the ongoing mitigation projects and the need for personal preparedness.

AH12 Hazard Mitigation Fund: Creation of a disaster and hazard mitigation fund would allow financial commitments to be made quickly to support hazard mitigation or response. However, with the current lack of property tax revenue and other competing needs of Reservation residents, the availability of funding to meet immediate emergency needs, including early hazard mitigation activities, and support disaster preparedness efforts is limited. Federal assistance programs require various matching fund contributions from applicants and are not guaranteed to exist in the future. Hence, creation of a hazard fund is necessarily a long-term action; the importance of this action will depend on the availability of future outside funding.

6.2.2. Floods

The following mitigation actions apply to the different flood hazards on the Reservation.

6.2.2.1. Current Flood Mitigation Actions

To date, various governmental agencies in the Nooksack River basin have used several different approaches to reduce the costs and impacts of flooding. Flood control structures, channel maintenance, and flood warnings are used to protect existing properties in flood hazard areas; whereas, land use plans and development regulations are used to prevent future development that would be vulnerable to flooding and reduce the impacts of new construction on flooding. A more complete description of past and current flood mitigation activities is available in the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a).

Flood Control, Elevation, and Flood-Proofing: The primary flood control measures protecting the riverine floodplain on the Reservation are the levees along the bank of the Nooksack River and the sea wall along Lummi Bay. In addition, Marine Drive was raised after the 1990 floods to reduce the frequency of closures during low magnitude floods. However, Marine Drive was still inundated by less than 1-year floods. In 2011, a section of Marine Drive was elevated and a box culvert installed as part of the Smuggler's Slough Restoration Project to improve salmon habitat and reduce flooding in the area. Many of the existing homes in the floodplain along Haxton Way were raised to the base flood elevation after the 1990 floods (LIBC 1997). Some homes west of Lummi Shore Road were also flood-proofed after the 1990 floods (Deardorff 1996). The Whatcom County Comprehensive Flood Hazard Management Plan (CFHMP) for the lower Nooksack River describes other past and current mitigation activities that have occurred upstream from the Reservation (Whatcom County 1997a, 1999).

Rip-rap shore armoring was used along most of the length of Lummi Shore Road to reduce coastal flood impacts and prevent erosion that undermined the road and created a public health and safety hazard. The recognized negative physical and biological effects of this project are being mitigated through a beach nourishment program.

Marine Drive Mitigation: Marine Drive, which floods frequently and early during flood events, was raised after the 1990 floods to prevent inundation during small floods. However, raising the road had the effect of limiting floodwater passage and diverting more of the overflow toward Haxton Way. In 2011, the Restoration Division of the Lummi Natural Resources Department completed the elevation of Marine Drive between the "Y" with Lummi Shore Road and the

Kwina Slough Bridge to restore fish passage between Bellingham Bay and Lummi Bay, as well as to reduce flooding in the area. In addition to elevating the road, this project included replacing an undersized culvert with a new 12 foot by 6 foot box culvert and a self regulating tidegate to provide for underflow. Part of the Kwina Slough levee downstream from Marine Drive, which was already breached in several places due to the 2009 flood, was removed and replaced with a channel to connect Kwina and Smuggler's sloughs. The elevation of Marine Drive is part of an ongoing effort to enhance fish habitat and reduce flooding. This project will not alleviate flooding on all flood-prone stretches of Marine Drive, but is a first step in a long-term strategy. The Natural Resources Department is currently working with Whatcom County to address flooding while enhancing fish habitat on- and off-Reservation along the remainder of Marine Drive and along Ferndale Road.

Land Use Plans and Development Regulations: The Lummi Planning and Public Works Department administers regulations that control development in flood hazard areas on the Reservation. To reduce flood vulnerabilities, the LIBC adopted floodplain regulations in 1997 in the form of the Flood Damage Prevention Code (LCL Title 15A) (Appendix D). Following the adoption of LCL Title 15A, the Lummi Nation joined the National Flood Insurance Program (NFIP) on October 14, 1997. The Lummi Nation moved from the emergency phase to the regular phase of the NFIP with the release by FEMA of final Flood Insurance Rate Maps (FIRMs) and a Flood Insurance Study for the Reservation and the surrounding area on January 16, 2004. The lack of FIRMs for the Reservation was the only requirement that kept the Lummi Nation in the emergency phase of the NFIP; the previous FIRMs for the Nooksack River and coastal shorelines were released by FEMA in 1990, but they contained no data for the Lummi Reservation. On November 16, 2007, revised FIRMs (Panel 1165E and Panel 1155E) were released for the Sandy Point and Neptune Beach areas. Additional FIRM revisions are underway. These projects, the Coastal Preliminary Map Revision (pursuant to the 2013 Coastal Flood Study [RiskMAP] Partnership Agreement) and the Sumas Preliminary Map Revision, are expected to be completed by December 2016. The availability of flood insurance and regulation of development within the floodplain will help reduce the overall damage and costs on the Reservation after future floods. In addition, by joining NFIP, the Lummi Nation is eligible to apply for state and federal grant programs to reduce flood hazards and repair flood damages.

The Lummi Nation's participation in the NFIP was improved through a Community Assistance Visit (CAV) with FEMA that closed on April 28, 2005. The CAV resulted in revisions to Title 15A of the Lummi Code of Laws, the creation of a Lummi Nation Floodplain Development Permit and associated application, and the development of special procedures for the issuance of permits for development in the floodplain. A second CAV during October 2007 recommended that the system for conducting floodplain determinations and ensuring compliance with Lummi Nation Floodplain Development Permit conditions be improved. This recommendation was addressed by changing practices so that permits are only issued after a pre-construction survey and the certificate of occupancy is only issued after receipt of the completed elevation certificate. The CAV also recommended the Lummi Nation Building Code be changed to add a requirement to display a 9-1-1 address sign. In 2012, a third Community Assistance Visit was conducted; no major changes to floodplain development regulations or permitting procedures were recommended.

In addition, the Lummi Nation joined the Community Rating System (CRS), which became effective on May 1, 2010. In the CRS, communities are rated by FEMA depending on the floodplain management practices that are implemented beyond the minimum mandated for membership in the NFIP and by public education efforts. If a community scores well in the CRS, then discounted flood insurance premiums are available to community members. In 2010, the Lummi Nation qualified as a Class 8 community, meaning that Reservation residents who purchased flood insurance using the Lummi Nation Community ID (No. 530331) received a 10 percent discount on policy premiums for property within the Special Flood Hazard Area (SFHA) and a 5 percent discount outside of the SFHA. Following the CRS Community Verification Visit in September 2013, the Lummi Nation's CRS rating improved to a Class 7, increasing the discount in the SFHA to 15 percent effective October 1, 2014. The Lummi Nation scored sufficient points in 2013 to move up to a Class 6 (20 percent discount in SFHA), but was not eligible for this improvement because the LIBC's building code enforcement has not been evaluated by the Building Code Effectiveness Grading System (BCEGS), a prerequisite for Class 6 communities. Adoption of the International Building Code would likely ensure a high BCEGS rating and allow the Lummi Nation to again improve the CRS rating for the Reservation.

Two Natural Resources Department staff members are Certified Floodplain Managers, which has allowed the department to provide further technical support to the Planning and Public Works Department in the implementation of the NFIP and LCL Title 15A.

The National Flood Insurance Program establishes a 100-year floodplain that is divided into two zones: a floodway and a flood fringe. Development may be permitted in these areas if it satisfies conditions and requirements regarding the height of the first floor of a structure above the projected 100-year flood elevation, flood-proofing construction, displacement of floodwaters, and related concerns.

Similarly, Executive Order 11988 of May 24, 1977, prohibits non-water-dependent development in a floodplain unless there is no practicable alternative. This Executive Order requires federal agencies to recognize the significant value of floodplains and to consider the public benefits that would be realized from restoring and preserving floodplains. The objective of Executive Order 11988 is avoidance, to the extent possible, of long- and short-term adverse impacts associated with occupancy and modification of the base floodplain (100-year floodplain) and the avoidance of direct and indirect support of development in the base floodplain wherever there is a practicable alternative. Executive Order 11988 was amended on January 30, 2015 with the issuance of Executive Order 13690 (*Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*). Executive Order 13690 established more protective flood risk management standards for federal investments as part of President Obama's national policy on climate change. The standard mandates that all federally funded projects in and affecting floodplains must meet one of three new requirements: (1) use data and methods informed by best-available, actionable climate science, (2) build two feet (standard projects) or three feet (critical facilities) above the 100-year flood elevation, or (3) build to the 500-year flood elevation.

Title 15A of the Lummi Nation Code of Laws (LCL) prohibits any development in a floodway that would cause 100-year flood levels to rise. Also prohibited in a floodway are all new construction and substantial improvement of residential structures, as well as repair or

improvement of existing structures, if these activities will increase the ground floor area. Title 15A allows development in the flood fringe, but requires the following measures, among others, to minimize flood damage:

- The lowest floor of new and substantially improved residential structures, including an occupied basement, must be elevated at least one foot above the 100-year flood elevation;
- New construction, substantial improvements, and manufactured homes must be anchored to prevent flotation, collapse, or lateral movement;
- Construction and utility design should be consistent with minimizing flood damage;
- Subdivisions should be consistent with minimizing flood damage;
- Enclosed areas below the lowest floor of new and substantially improved residential structures should be designed to minimize structural damage; and
- New and substantially improved nonresidential structures must have their lowest floor elevated at least one foot above the 100-year flood elevation or be flood-proofed and designed to resist the forces of floodwaters up to this elevation.

Pursuant to LCL Title 15A, in coastal flood areas with velocity hazards, all new construction and substantial improvements must be elevated on pilings or columns so that the bottom of the lowest horizontal structural member is elevated at least one foot above the 100-year flood level. The foundation must also be anchored to resist the total force of wind and water acting simultaneously on the whole structure. All new construction must also be located landward of the reach of ordinary high water. The use of fill for structural support and the alteration of sand dunes that would increase potential flood damage are prohibited.

Critical facilities (e.g., hospitals, schools, nursing homes, police stations, fire stations, and facilities for hazardous waste storage) must, to the extent possible, be located outside the Special Flood Hazard Area (SFHA, the area inundated by a 100-year flood). If constructed within the SFHA, they must be elevated three feet or more above the base flood elevation. Toxic substances must be protected from exposure to floodwaters and elevated access routes must be provided, to the extent possible, to all critical facilities.

Current land use on the Reservation is relatively compatible with flooding in the Nooksack River floodplain, but is relatively incompatible with flooding along the low-lying coastal zones. Historical agricultural use of the riverine floodplain and an awareness of the flood risk have resulted in a low housing and commercial density in this area and in flood-proofing actions to reduce the probability of flood damage. Conversely, the desire for scenic waterfront properties and a lack of awareness of or respect for flood hazards has resulted in a high housing density along the low-lying coastal zones of the Reservation. Most of the properties and many of the structures along the western Sandy Point Peninsula and Neptune Beach shorelines lie within the coastal velocity zone designated on the FIRMs for the Reservation (FEMA Map No. 53073C1155E and 53073C1165E). Based on these FIRMs, field observations during flood events, and high-resolution topographic mapping, most of these residences are not in compliance with LCL Title 15A provisions for flood damage reduction presumably because they are pre-FIRM construction.

Critics of FEMA's flood management system, in particular the NFIP, have pointed out that it has actually led to increased flood damages in the United States. This occurs in part because the program encourages development in the floodplain and coastal flood zones by providing federally backed flood insurance for damages to houses and property within these areas. This financial safeguard for developing within flood-prone areas along with a false sense of security from regulations and flood control structures that may not be adequate imposes additional costs on both property owners and tax payers (Tillamook County 1996). To avoid such problems, it is important for land use plans and regulations to direct development to locations that are outside of flood-prone areas.

Flooding on the Reservation is strongly affected by land uses and floodplain management upstream from the Reservation. Whatcom County has jurisdiction over land use in much of the lowlands upstream from the Reservation. West of the foothills and mountains of the Cascade Range, forested uplands are regulated by either the state or federal government. To meet requirements of the Washington State Growth Management Act, the Whatcom County Comprehensive Plan was adopted in 1997 and revised in 2005 (Whatcom County 1997b, 2005). This plan includes the following policies:

- Discourage development in areas prone to flooding.
- Limit lands in the 100-year floodplains to low intensity land uses such as open space corridors or agriculture.
- Use the Whatcom County Comprehensive Flood Hazard Management Plan (CFHMP) as a basis to balance land use and flooding.
- Discourage expansion of urban growth areas into flood-prone areas and consider danger to individuals related to flooding when designating land use in other areas.
- Encourage multi-purpose problem solving relative to flooding, aquifer recharge, improved water quality, water for human consumption, and fish habitat. Consider the purchase of land along the Nooksack River for flood water storage that could be utilized by cities and water providers.
- Development in flood-prone areas must comply with adopted regulations to mitigate identified flood hazards.

About 75 percent of the 20,000 acre lower Nooksack River floodplain is zoned for agricultural use and about an additional 10 percent is zoned for other open space uses. Thus, approximately 85 percent of the floodplain is zoned for flood compatible uses. Retaining such uses is important not only to avoid flood damages but also to provide floodwater storage during large floods (Whatcom County 1997a). Whatcom County adopted floodplain regulations and entered the regular phase of the NFIP in 1977.

6.2.2.2. Proposed Flood Mitigation Measures

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, Table 6.2 summarizes the proposed flood mitigation actions; these actions are identified as “FA” (an acronym for “flood action”) followed by a unique identification number. In the 2010 update, former Short-Term Flood Mitigation Action 1 was combined with AH3, former Long-Term

Flood Mitigation Action 3 became AH14, and former Long-Term Flood Mitigation Action 6 was moved into the current mitigation section.

Table 6.2 Proposed Flood Mitigation Actions

FA1	
Identify funding to complete elevation certificates for pre-FIRM tribal residences and businesses located in the floodplain.	
Coordinating Organization:	Natural Resources and Planning and Public Works departments
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External
FA2	
Identify funding to purchase flood insurance for LIBC buildings in or adjacent to the floodplain.	
Coordinating Organization:	Natural Resources and Planning and Public Works departments
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability and Long-Term Costs, Public Health and Safety
Funding:	Tribal, External
FA3	
Obtain funding for construction of 100-year setback levee along Ferndale Road.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Coordinate with FEMA and Whatcom County in pursuit of funding (e.g., Pre-Disaster Hazard Mitigation Grant Program, Flood Control Assistance Account Program). 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Develop Partnerships, Public Health and Safety
Funding:	External
FA4	
Obtain funding for raising Slater Road and providing for underflow.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Coordinate with FEMA and Whatcom County in pursuit of funding (e.g., Pre-Disaster Hazard Mitigation Grant Program, Flood Control Assistance Account Program). Also coordinate with industries at Cherry Point and the City of Ferndale. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Develop Partnerships, Public Health and Safety, Improve Fish and Wildlife Habitat
Funding:	External

Table 6.2 Proposed Flood Mitigation Actions

FA5	
Obtain funding for construction and maintenance of a new culvert from the Nooksack River to the Lummi River.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Coordinate with FEMA and Whatcom County in pursuit of funding (e.g., Pre-Disaster Hazard Mitigation Grant Program, Flood Control Assistance Account Program). 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Develop Partnerships; Public Health and Safety, Improve Fish and Wildlife Habitat
Funding:	External
FA6	
Monitor condition of culverts, tide gates, and seawall and identify funding sources for potential maintenance or repairs.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Coordinate with FEMA and Whatcom County to address necessary pre- and post-disaster repairs. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Develop Partnerships, Public Health and Safety
Funding:	External
FA7	
Obtain funding for raising Haxton Way and providing for underflow.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Coordinate with FEMA and Whatcom County in pursuit of funding (e.g., Pre-Disaster Hazard Mitigation Grant Program, Flood Control Assistance Account Program). 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Develop Partnerships, Public Health and Safety, Improve Fish and Wildlife Habitat
Funding:	External
FA8	
After modeling of Nooksack River flooding is completed by Whatcom County, analyze flood levels under future conditions of land use and assess the benefits of more protective development standards.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Coordinate with Whatcom County to review models of Nooksack River flooding and to analyze the benefit-cost ratios of various development standards. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Develop Partnerships, Public Health and Safety
Funding:	Tribal, External

Table 6.2 Proposed Flood Mitigation Actions

FA9	
Enforce the provisions of LCL Title 15A for new development in the coastal floodplain and continue to pursue acquisitions of existing vulnerable structures.	
Ideas for Implementation:	
<ul style="list-style-type: none">• Obtain funding for acquisition and removal or relocation.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Reduce Vulnerability, Public Health and Safety
Funding:	Tribal, External

FA1 and FA2 Protection of Existing Development in Flood-Prone Areas: Protection of new development from flooding is a necessary preventive solution to flooding, but this does not solve flooding and erosion problems for structures that have already been built in hazardous areas. These structures and properties receive protection from existing measures, including numerous levees and revetments and flood warning and emergency response programs. However, the overall potential for flood damage remains high. Mitigation alternatives for existing developments include the following:

1. Raise or flood-proof structures;
2. Relocate or buyout existing structures;
3. Construct flood control structures to protect properties;
4. Relocate manure lagoons; and
5. Do nothing.

Existing structures will need to be addressed on a case-by-case basis. The best alternative for each case will vary depending on the specific factors involved.

Several existing structures on the Reservation were raised or flood-proofed to base flood elevation after the 1990 floods. More recently, acquisition and removal of structures in flood-prone areas of the Reservation include one structure purchased with Pre-Disaster Mitigation-Competitive (PDM-C) grant funds on the Sandy Point Peninsula in 2005, two structures purchased with Hazard Mitigation Grant Program (HMGP) funds (one on the Sandy Point Peninsula and one in Floodplain assessment area) in 2010, and one structure acquired by the LIBC as part of the Smuggler's Slough Restoration Project in 2011.

FA3 Nooksack River Mitigation: The Nooksack River regularly overtops the east and/or west bank levees downstream from Ferndale during larger floods. The resulting floodwaters inundate farmlands, damage structures in the floodplain, threaten the Lummi Bay seawall, and cut off road access to the Lummi Peninsula and the Lummi Island ferry terminal. As described previously, the cost of damages and lost economic activity during such flooding is high.

Moving the west bank levees approximately 500 feet further from the river was a flood management alternative for the Nooksack River that was analyzed by Whatcom County using

computer modeling (Whatcom County 1997a). Such a large setback distance was chosen to evaluate whether using setback levees has merit for further consideration. The levee section considered was from just south of the Ferndale wastewater treatment plant to just south of Rayhorst Road and was evaluated at the current levee height. Model results indicated that the average capacity increase along this river segment would be about 12,000 cubic feet per second (cfs). The improvement upstream was much less, only about 4,500 cfs at the treatment plant and about 3,000 cfs at the southern city limit of Ferndale. Thus, the evaluated levee setback substantially increased river capacity along the setback segment, but the upstream benefit was not considered significant (Whatcom County 1997a).

The Whatcom County Comprehensive Flood Hazard Management Plan (CFHMP) describes three options for flood hazard management using flood control along the Nooksack River below Ferndale:

1. Keep the alignment and protection level of the levees essentially the same as they are today and allow historical flooding patterns to continue;
2. Construct a 100-year levee from Ferndale to Lummi Shore Road, along or west of Ferndale Road, that provides a wider flow corridor to Bellingham Bay and limits overflows to Lummi Bay; or
3. Strengthen and raise the existing west bank levees to prevent overflows to Lummi Bay.

Under the first option, the problems of Haxton Way inundation and associated isolation of the Lummi Peninsula and Lummi Island, potential damage to the Lummi Bay seawall, and inundation of floodplain properties would remain. To minimize dangerous and costly levee breaches, improvements would be required to ensure levees are stable when overtopping occurs. This would involve selecting and designing the overflow locations. The second option would require the compensation of property owners in the form of easements, buyouts, or relocation for some properties lying between the old levees and the new levee. About ten improved properties would be affected. The levee elevation required would be eight to nine feet higher than the existing elevations along Ferndale Road and ten to twelve feet higher than the ground elevations west of Ferndale Road. The estimated construction and total project costs are \$2.1 million and \$4.4 million for the Ferndale Road approach and \$1.5 million and \$3.1 million for the levee across agricultural land west of Ferndale Road (Whatcom County 1997a). If not already included, a bridge crossing the Lummi River channel should be a part of this project. The third option would increase the flow through the east bank overflow corridor during large floods. Raising the existing west bank levees would have estimated construction and total project costs of \$1.1 million and \$2.3 million (Whatcom County 1997a).

The Whatcom County CFHMP recommends the second option. Under this option, existing agricultural levees along the west bank would remain overtoppable, but an overflow corridor would be in place to direct floodwaters to Bellingham Bay instead of Lummi Bay. Buyouts or flood-proofing would be required for properties in the overflow corridor. However, this option could avoid the cost of raising Haxton Way, reduce the probability of isolating the Lummi Peninsula and Lummi Island, and would not increase flood flow in the overflow corridor along the east bank (Whatcom County 1997a). The Lummi Nation Flood Damage Reduction Plan (FDRP) adopted this option as a high priority mitigation action (LWRD 2001a).

To improve channel complexity, increase habitat quality and quantity for salmonids, and reconnect the river with the floodplain, the Lummi Nation supports moving the agricultural levees further from the river. This action would provide another increase in the flood capacity of the river channel and the flood storage of the floodplain.

The Whatcom County CFHMP recommendation to build a 100-year setback levee along Ferndale Road is in line with the priorities and policies of the Lummi Nation. This recommendation is also consistent with the recommended flood mitigation actions of the Whatcom County Natural Hazards Mitigation Plan (Whatcom County 2004). Such a levee would create (according to the Whatcom County CFHMP) a regulatory floodway. Without the 100-year setback levee or in the event of a failure of such a levee, flood overflows would spread over the floodplain on the Reservation and would require elevation, relocation, or flood-proofing of the vulnerable existing structures in the floodplain. The Lummi Nation therefore recommends continued implementation of LCL Title 15A regulations in the floodplain behind any future levee. In addition, failure of a 100-year setback levee could result in substantial damage to Haxton Way and Hillaire Road, temporarily closing them. After floodwaters recede, closure of these roads would leave Marine Drive (susceptible to further flooding) and the unimproved roadway along the Seapond Dike as the only road access to Lummi Peninsula until repair of Haxton Way or Hillaire Road occurred. Therefore, instead of only constructing a 100-year levee, the Lummi Nation recommends also raising Haxton Way to the level of the 100-year, future-conditions flood to provide access to the Lummi Peninsula during floods. Adequate flow capacity under the road would be required and the Lummi Bay seawall may have to be modified to allow for the rapid release of floodwaters in the event that the 100-year levee is breached.

FA4 Slater Road Mitigation: Slater Road is the primary transportation route from Interstate 5 to the Reservation and the Silver Reef Hotel, Casino & Spa, and the primary transportation corridor to the industrial areas north of the Reservation (i.e., Phillips 66 refinery, Alcoa-Intalco Works aluminum smelter). Slater Road is inundated and closed on the east side of the Nooksack River even during small flood events because it crosses the overflow corridor south of Tennant Lake. Large floods can close the road on both sides of the river for several days. The level of flood that closes Slater Road (approximately 27,000 cfs) closes Marine Drive as well, leaving the roads through or north of Ferndale as the only routes to the west side of the river.

Mitigation alternatives for Slater Road include the following:

1. Maintain the current elevation of the road, allowing periodic inundation;
2. Raise the roadway on the east side and provide an 800-foot bridge to allow passage of the 100-year flood event under the road; or
3. Raise the roadway to the 100-year level on both sides of the river and provide a bridge or causeway to allow passage of floodwaters on both sides of the river.

Since the Whatcom County CFHMP recommends maintaining the overflow corridor on the east side of the Nooksack River, the periodic closures of Slater Road and the resulting traffic congestion in Ferndale would continue under the first option. The second option, with an estimated total project cost of \$9.6 million, would keep the road open through the overflow corridor, but the road would still be inundated on the west side of the river during large floods. Because the second option represents an incomplete solution, the Whatcom County CFHMP

recommended the first option in the short-term and reconsideration of the second option in the future as traffic demands change and if special financing becomes available (Whatcom County 1997a, 1999). The third option, adopted as a long-term priority in the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a), would preserve overflow corridors on both sides of the river, maintain direct access to important economic areas both on- and off-Reservation, protect public health and safety, and reduce traffic congestion in Ferndale.

In cooperation with Whatcom County, the Lummi Nation applied for and received a 2005 FEMA Pre-Disaster Mitigation-Competitive (PDM-C) project grant for the elevation of Slater Road east of the Nooksack River bridge. The Slater Road Elevation Project was determined to be the most cost-effective alternative based on new traffic count information for Slater Road and Marine Drive, data on lost revenue for the Silver Reef Hotel, Casino & Spa during Slater Road closures, eligibility for the FEMA Pre-Disaster Mitigation-Competitive grants, and new information about the future plans for the east bank levee. The Washington State Department of Fish and Wildlife owns the parcels adjacent to the east bank of the river north and south of Slater Road, and the associated portion of the levee, and does not intend to maintain the levee on these parcels. This project was determined to be eligible for a PDM-C project grant through a benefit-cost analysis with a ratio greater than 1.0. The project would elevate an approximately 1 mile long section of Slater Road an average of 12 feet, which will be above the 100-year flood level, including a 389 foot bridge span over Tennant Creek. Elevation of this frequently flooded section would allow continued access to the Reservation, the Cherry Point industries, and Lummi Island during a 100-year flood event.

After pre-award activities, the grant was received in February of 2006 and the project was scheduled to be completed in early 2009. Because the section of Slater Road to be elevated is located off of the Lummi Reservation, the Lummi Nation entered an Interlocal Agreement with Whatcom County. Through this agreement, Whatcom County and the Lummi Nation were to jointly fund and implement this project. However, the final estimates for the construction costs obtained in October 2007 exceeded the previously estimated project budget by approximately \$5 million. As a result, the PDM-C grant was terminated because the project could not be completed before the 5 year maximum project duration was exceeded. Efforts continue to secure funding for this project.

FA5 Lummi River Mitigation Activities: The Lummi River currently receives flow from the Nooksack River only at relatively high flow levels (greater than approximately 10,000 cfs). Water discharges to the Lummi River through a four-foot culvert in the levee that is reportedly collapsed. The normal flow capacity of this culvert is less than the flow capacity of the Lummi River; its poor condition presumably reduces the flow further.

Mitigation alternatives for the Lummi River include the following:

1. Maintain the current flow capacity of the Lummi River diversion culvert;
2. Increase the flow capacity of the culvert to match the capacity of the Lummi River channel; or
3. Enlarge the Lummi River channel and increase the diversion from the Nooksack River.

A relatively modest increase of Lummi River channel capacity to 4,600 cfs (less than 10 percent of the November 1990 flood flow) would cost up to about \$15.8 million and Whatcom County does not consider this to be a cost-effective option at this time (Whatcom County 1997a). The mitigation alternative recommended by the Whatcom County Comprehensive Flood Hazard Management Plan (CFHMP) for the Lummi River is not to increase the river capacity, but instead to rehabilitate the existing culvert at the confluence with the Nooksack River, including a gate or similar flow control structure, and to modify downstream structures if necessary (Whatcom County 1997a).

Pursuant to LIBC Resolution No. 98-62, the Lummi Natural Resources Department has been evaluating the potential for a Nooksack Estuary Recovery Project (NERP). The NERP is a project to restore coastal wetlands and marshes on the Lummi Reservation, including the possible reconnection of the Lummi and Nooksack rivers (instead of the Lummi River only receiving Nooksack River water during high flows). In general, the NERP addresses hydromodification in the Lummi River and Nooksack River estuaries. If the historical flow is not restored to the Lummi River, increasing the flow capacity of the diversion culvert to match the capacity of the Lummi River channel may be a desirable action that would enhance the estuarine character of Lummi Bay. Additionally, the 2005 Lummi Nation Nooksack River Estuary Habitat Assessment recommends the replacement of the collapsed culvert to improve fish passage between the Lummi and Nooksack Rivers and improve floodplain function by establishing a more consistent flow regime (LNR 2005). The poor water quality in the Nooksack River and the threat it represents to tribal shellfish beds in Lummi and Portage bays currently limits the feasibility of this option.

Consistent with the desire of the Lummi Nation to improve the quality of the Lummi River estuary (via the NERP) and the policy of reconnecting the river with the floodplain, this MHMP recommends increasing the flow in the Lummi River by repairing, maintaining, and possibly increasing the capacity of the culvert from the Nooksack River. Although contingent on improving the quality of Nooksack River water to protect tribal shellfish beds in Lummi Bay, such an action will reduce the downstream Nooksack River flood flow and reestablish a historic migration corridor for anadromous fish. If limited to the capacity of the Lummi River channel, the flow increase should not contribute to flooding in the floodplain. If flow is reestablished on a fairly regular (or even continuous) basis, it could improve habitat quality in the Lummi River and in the Lummi Bay estuary, but will reduce instream flow in the Nooksack River downstream from the Lummi River distributary.

FA6 Lummi Bay Seawall Mitigation Action: The Lummi Bay seawall is threatened by overflows and levee breaches occurring along the west bank of the Nooksack River. In 1998, the six non-functioning tide gates on the south side of the Lummi River, mounted on 36 inch diameter corrugated steel culverts, were replaced by five concrete box culverts, 4 feet wide by 6 feet tall, fitted with “flapper” gates made out of aluminum. These gates largely prevent saltwater from entering the delta and associated agricultural land during high tides. In addition, a fuse plug was added to the seawall on the south side of the Lummi River to provide for the release of impounded floodwater during a large flood, and three box culverts (5 foot by 5 foot) drain the northern distributary channel of the Lummi River. Whether these two sets of culverts and the fuse plug will eliminate the hazard of a seawall breach during a large flood is not yet known. A 100-year setback levee along the west side of the Nooksack River, as described in the previous

section, would minimize this threat. If a setback levee is not constructed, the following options would address a potential seawall breach:

1. Add more culverts with tide gates;
2. Construct additional, easily repairable fuse plugs in the seawall to accelerate floodwater drainage during severe flooding;
3. Remove all or part of the seawall for habitat restoration or mitigation banking purposes (LNR 2005); or
4. Maintain the seawall as it exists.

Because the 100-year setback levee that was adopted as a high priority in the Lummi Nation FDRP and recommended in the Whatcom County CFHMP would minimize the threat to the seawall, none of the first three alternatives are recommended in the short-term. Continued maintenance of the existing structure, culverts, and tide gates is recommended in anticipation of the construction of a 100-year levee.

FA7 Haxton Way Mitigation Action: Haxton Way, the primary transportation route onto the Lummi Peninsula and to the Whatcom County ferry terminal that provides access to Lummi Island, is inundated by floodwaters that overflow or breach the west bank levees of the Nooksack River. Access to the peninsula and island can be cut off for days during a large flood.

Mitigation alternatives for Haxton Way include the following:

1. Maintain the current elevation of the road, allowing periodic inundation;
2. Raise 7,000 feet of the roadway, with bridges or culverts included in the project to allow passage of floodwaters under the road and improve salmon habitat;
3. Protect the road with a 100-year setback levee along Ferndale Road.

The periodic inundation of Haxton Way and the resulting isolation of the Lummi Peninsula and Lummi Island are a threat to public health and safety, especially in the case of a medical emergency. The loss of road access to the area also has a substantial economic cost, both from a reduction of business and from employees unable to get to work. These impacts, combined with effects in other areas of the west bank floodplain, make the first option (maintaining existing elevation) undesirable. The project described in the second option (making the roadway a causeway) had in the mid-1990s an estimated construction cost of \$1.8 million and total project cost of \$3.8 million (Whatcom County 1997a, 1999). While this project would solve the access problem, other floodplain problems would remain, including extended inundation of agricultural lands and a threat to the Lummi Bay seawall. A comprehensive solution to these problems is preferable. The Whatcom County CFHMP recommends the third option, which would protect Haxton Way, the seawall, and much of the floodplain with a 100-year setback levee at a cost that is comparable to the cost of raising Haxton Way. However, the Whatcom County CFHMP also recommends that until this option is accepted and implemented, it may be appropriate to raise the lowest sections of Haxton Way to prevent periodic inundation in the interim period (Whatcom County 1999). The Lummi Nation Flood Damage Reduction Plan (FDRP) adopted the second option as a short- and long-term priority, protecting the road both before a 100-year setback levee is built and in the case of a future 100-year levee failure (LWRD 2001a).

Summary of Road Recommendations: In the Flood Damage Reduction Plan (LWRD 2001a), the Lummi Nation recommends raising Ferndale Road by constructing a 100-year setback levee that extends along Ferndale Road from Ferndale to Kwina Slough, then along the north side of Kwina Slough to Marine Drive, and finally along Marine Drive to Lummi Shore Road. The levee should include a bridge over the Lummi River channel where Ferndale Road crosses the river and culverts allowing flow under Marine Drive. This levee will prevent the inundation of the Nooksack River floodplain on the Reservation and thereby protect Haxton Way, which in turn will maintain road access to the Lummi Peninsula during large floods. As described previously, elevating Marine Drive from the Kwina Slough bridge to Lummi Shore Road was completed in 2011 as an element of the Smuggler's Slough Restoration Project. Additionally, the Lummi Nation recommends the elevation of Slater Road to the 100-year flood level east of the Nooksack River, a project that would include a bridge to allow floodwaters to pass underneath the roadway. This action will keep an important transportation corridor open during floods and will thereby minimize the economic impact of flooding. Finally, the Lummi Nation supports raising Haxton Way to the 100-year flood level and providing for the flow of floodwaters under Haxton Way. This action will provide access to the Lummi Peninsula and Lummi Island in case of a breach of the 100-year setback levee along Ferndale Road and Marine Drive.

FA8 Development and Land Use in Flood-Prone Areas: The Lummi Planning and Public Works Department is developing a Comprehensive Land Use Plan for the Lummi Reservation. This plan will identify areas that will be developed for residential, commercial, industrial, and agricultural purposes, as well as show areas that require protection (e.g., Special Flood Hazard Areas, wetlands, and aquifer recharge zones). Together, the Comprehensive Land Use Plan, the Land Use, Zoning, and Development Code (LCL Title 15), the Flood Damage Prevention Code (LCL Title 15A), the Coastal Zone Management Plan, the Building Code (LCL Title 22), and the Water Resources Protection Code (LCL Title 17) will reduce flood damage by ensuring that land use is compatible with the landscape, that infrastructure is developed in a coordinated fashion, and that development in Special Flood Hazard Areas is minimized and flood-protected.

One solution to potentially increased future flood levels is to require higher elevation of the first floor of new structures within the floodplain; the current elevation requirement is one foot above base flood elevation (100-year flood elevation). A safer standard is to require that all new structures be elevated or flood-protected to an elevation of three feet above the FIRM base flood level within the 100-year floodplain and to an elevation of one foot above the flood elevation within the designated 500-year floodplain (not yet determined for the Reservation).

Mitigation alternatives for development and land use include the following:

1. Retain the current standards in Flood Damage Prevention Code (LCL Title 15A);
2. Increase the standards in Flood Damage Prevention Code (LCL Title 15A);
3. Prohibit new development in high hazard areas and restrict development in other flood-prone areas to flood-compatible land uses unless there is no practicable alternative;
4. Build a 100-year setback levee with three feet of freeboard along Ferndale Road; or
5. Combination of the above.

An analysis of future-condition flood levels and of the benefit-cost ratio of increasing development standards would be necessary in order to choose the best alternative listed above.

FA9 Low-Lying Coastal Areas: In coastal areas subject to hazardous velocity flows, the Lummi Nation recommends enforcement of the restrictions in the Flood Damage Prevention Code (LCL Title 15A) for new development and a program of buyout and/or relocation for vulnerable existing structures. Restrictions on new structures will keep the problem from getting worse and an acquisition program for existing structures (probably implemented in response to damaging future floods) will avoid perpetuating the problem (LWRD 2001a). In areas subject to coastal flooding but not velocity hazards, the Lummi Nation recommends elevation or flood-proofing of new and existing development as described in LCL Title 15A. The assessment of potential mitigation projects for existing development in coastal areas of the Reservation is addressed in more detail in FA1 and FA2.

The Lummi Nation applied for and received a 2005 Pre-Disaster Mitigation-Competitive (PDM-C) grant for the acquisition and removal up to three residential structures from the V Zone or coastal A Zone on the Sandy Point Peninsula. Initially, five properties within the V Zone were identified using the Lummi Nation Geographic Information System (GIS) and the Flood Insurance Rate Maps (FIRMs) for the Reservation. Letters were sent to each property owner seeking voluntary interest in the acquisition project. The prospective properties were determined through Benefit-Cost Analyses and completion of Elevation Certificates to be eligible for the project and were included in the PDM-C application. The acquisition and removal of one property was completed in December 2006. Three of the five original properties sold to other buyers during the period between application and receipt of the grant. In 2010, two additional homes, one located on the Sandy Point Peninsula and one located in the Floodplain assessment area, were acquired and removed using FEMA Hazard Mitigation Grant Program (HMGP) funding. The cumulative effect of removing these structures will be to reduce the costs to life and property in case of coastal flooding.

6.2.3. Earthquakes

Earthquake damage occurs when structures and/or lifelines (e.g., roads, utility lines) are not designed to withstand severe shaking, are on ground that amplifies shaking, or are on ground that liquefies because of shaking. While it is possible to design structures to withstand earthquakes, it can be prohibitively expensive to design for significant events. Most new buildings are designed with sufficient integrity for the occupants to safely survive the event and evacuate, but not necessarily to protect the building from damage. Thus, the main advantage of improved seismic design requirements is that they can protect lives, as well as maintain the functionality of the structure during and after lesser magnitude events. Buildings that were not built to an adequate seismic standard can often be retrofitted and strengthened to help withstand earthquakes and provide public safety. Further, developing knowledge of seismic hazards in specific areas before beginning development can potentially reduce or prevent property destruction and loss of lives. Because the Reservation faces an infrequent but significant earthquake hazard, identifying seismic-prone locations, adopting protective development policies, implementing damage reduction measures, and utilizing other mitigation techniques are essential to reducing risk from seismic hazards on the Reservation.

6.2.3.1. Current Earthquake Mitigation Actions

The LIBC originally adopted the Building Code (LCL Title 22) on January 5, 1968; an amended Building Code was adopted in January 2004. The original Building Code adopted the Uniform Building Code (UBC) of the International Conference of Building Officials (1975) by reference to govern construction within all areas of the Reservation. As a result, when the Uniform Building Code is updated, the changes take effect immediately on the Reservation. The UBC includes earthquake standards that are scaled to the earthquake hazard of an area; the Lummi Reservation is in Seismic Zone 3 (Southern California is in the highest zone, Zone 4). The next time that the Building Code is updated, the LIBC plans to adopt the International Building Code, which applies seismic design standards based on peak ground acceleration (PGA) values instead of seismic zones.

For construction of the Silver Reef Hotel, Casino & Spa, several actions have been taken to mitigate the earthquake hazard posed by liquefaction. Soil borings and cone penetration tests (from 58-71 feet below the ground surface) were conducted to determine the potential for liquefaction. The high groundwater table and loose sand and soft silt or clay layers that were found indicated that there was a high risk for liquefaction. This is confirmed by the liquefaction susceptibility maps produced by the Washington State Department of Natural Resources (DNR), which show a high susceptibility for the Floodplain assessment area (Palmer et al. 2004). Based on the results of these tests, GeoEngineers estimated that if there were no site improvements and a conventional foundation (i.e., shallow footings) were used, 4-6 inches of total settlement and 2-4.5 inches of differential settlement (the primary concern) could occur and lateral displacement was likely. To reduce the settlement potential, approximately 3 foot diameter columns of gravel and cobbles were placed to a depth of 20 feet below ground surface into the soils at regular intervals to strengthen the surrounding soil. Using this technique, less than 2 inches of total settlement and 0.5 to 1.5 inches of differential settlement could occur and lateral displacement is unlikely. Expected performance during the design earthquake is minor damage (LIBC 2001). Similar earthquake mitigation actions were taken for all of the subsequent expansion phases for the Silver Reef Hotel, Casino & Spa.

The Lummi Nation received a computer system and software in 2006 from the Washington State Division of Emergency Management and the University of Washington's Pacific Northwest Seismic Network to connect to and run the California Integrated Seismic Network (CISN) Display system. The CISN Display will allow Lummi Nation emergency responders to view information about an earthquake after the event to determine its severity and prioritize response efforts.

6.2.3.2. Proposed Earthquake Mitigation Measures

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, the proposed earthquake mitigation actions (earthquake action [EA]) are summarized in Table 6.3. The earthquake mitigation strategy remained unchanged during the 2010 and 2015 updates.

Table 6.3 Proposed Earthquake Mitigation Actions

EA1	
Encourage seismic strength evaluations of critical facilities on the Reservation to identify vulnerabilities and implement mitigation measures necessary to meet current seismic standards.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Develop an inventory of critical facilities that do not meet seismic standards; • Encourage owners of non-retrofitted reservoirs or water tanks to upgrade them to meet seismic standards; and • Encourage all water providers to replace all old cast iron pipes with ductile iron, and identify partnership opportunities with other agencies for pipe replacement. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	5 years
Plan Goals Addressed:	Protect Life and Property, Public Health and Safety
Funding:	Tribal, External
EA2	
Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Provide information to property owners, small businesses, and organizations regarding sources of funds (e.g., loans, grants); and • Explore options for including seismic retrofitting in existing programs such as low-income housing, insurance reimbursements, and pre- and post-disaster repairs. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Public Health and Safety, Increase Public Awareness
Funding:	Tribal, External
EA3	
Encourage purchase of earthquake hazard insurance.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Provide earthquake insurance information to Reservation residents; and • Coordinate with insurance companies and organizations to produce and distribute earthquake insurance information. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness
Funding:	External

Table 6.3 Proposed Earthquake Mitigation Actions

EA4	
Encourage reduction of structural and nonstructural earthquake hazards in homes, schools, businesses, and government offices.	
Ideas for Implementation:	
<ul style="list-style-type: none">• Provide information to government building and school facility managers and teachers on securing bookcases, filing cabinets, light fixtures, and other objects that can cause injuries and block exits;• Encourage facility managers, business owners, and teachers to refer to FEMA's practical guidebook <i>Reducing the Risks of Nonstructural Earthquake Damage</i>;• Encourage homeowners and renters to use <i>Is Your Home Protected from Earthquake Disaster? A Homeowner's Guide to Earthquake Retrofit</i> (IBHS 1999) for economic and efficient mitigation techniques;• Explore partnerships to provide retrofitting classes for homeowners, renters, building professionals, and contractors; and• Target development located in potential fault zones or in unstable soils for intensive education and retrofitting resources.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Public Health and Safety, Increase Public Awareness
Funding:	Tribal, External

6.2.4. Severe Winter Storms

The following mitigation actions apply to severe winter storms.

6.2.4.1. Current Winter Storm Mitigation Actions

Several winter storm mitigation measures are in place, including the following:

- Early warning of storms is provided by the National Weather Service (NWS), Whatcom County Division of Emergency Management, emergency notification services (e.g., MyStateUSA), radio (e.g., NOAA Weather Radio), television, and internet.
- Tribal government offices and schools commonly close when roads and driving conditions are hazardous.
- During recent winter storms, the Construction Division of the Lummi Planning and Public Works Department has coordinated road clearing with local contractors and Whatcom County Public Works (Kamkoff 2003).
- Vulnerable citizens typically receive assistance from family members, friends, neighbors, and/or the Lummi Nation Community Services and Police departments.

6.2.4.2. Proposed Winter Storm Mitigation Measures

Mitigation actions should focus on providing public information on emergency preparedness, warning and notification of the public, prioritization of roads and streets to be cleared, provision of emergency services, mutual aid with other public entities, and procedures for requesting state and federal assistance if needed.

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, the proposed severe winter storm mitigation actions (winter storm action [WSA]) are summarized in Table 6.4. The severe winter storm mitigation strategy remained unchanged during the 2010 and 2015 updates.

Table 6.4 Proposed Winter Storm Mitigation Measures

WSA1	
Enhance strategies for debris management for severe winter storm events.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Develop coordinated management strategies for de-icing roads, plowing snow, ensuring utility service, clearing roads of fallen trees, and clearing debris from public and private property. 	
Coordinating Organization:	Planning and Public Works Department, Police Department
Timeline:	Ongoing
Plan Goals Addressed:	Emergency Services, Public Health and Safety, Develop Partnerships
Funding:	Tribal, External
WSA2	
Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public and private infrastructure from severe winter storms.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Partner with responsible agencies and organizations to design and implement programs that reduce risk to life, property, and utility systems; and • Develop partnerships between utility providers and local public works agencies to document known hazard areas and implement actions to ensure timely response. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Emergency Services, Public Health and Safety, Develop Partnerships
Funding:	Tribal, External
WSA3	
Increase public awareness of severe winter storm mitigation measures.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Collect, develop, and distribute public education materials for protecting life, property, and the environment from severe winter storm events; • Distribute educational materials to Reservation residents and public and private sector organizations regarding evacuation routes during road closures; and • Target the vulnerable populace for disseminating preparedness information. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Increase Public Awareness, Protect Life and Property
Funding:	Tribal

6.2.5. Windstorms and Tornadoes

The hazards from windstorms and tornadoes are posed by high winds and accompanying damages. For this reason, the mitigation actions in this section apply to both hazards.

6.2.5.1. Current Windstorm and Tornado Mitigation Actions

The following mitigation actions are currently implemented for windstorm and tornado hazards:

- The Uniform Building Code adopted by reference in the Lummi Nation Building Code (LCL Title 22) sets a wind design standard of 80 mph for the Reservation.
- The Forestry Division of the Lummi Natural Resources Department manages hazard tree removal through the Lummi Nation land use permitting process (via the Technical Review Committee) and works to expedite hazard tree removal permits. The Forestry Manager has developed a Memorandum of Understanding between the Lummi Nation and the U.S. Bureau of Indian Affairs (BIA) that waives the BIA timber cutting permit for small clearings such as hazard tree removal.
- Provisions in the Flood Damage Prevention Code (LCL Title 15A) will reduce impacts due to the wind-driven waves that cause coastal flooding.
- Underground power lines were installed for two well sites, the Wex'li'em (Community Building), and the Lummi Nation School.

6.2.5.2. Proposed Windstorm and Tornado Mitigation Actions

The primary ways to reduce direct damage from high winds is to build wind-resistant structures and to keep debris, particularly trees, from falling onto structures. The Lummi Nation already has a building code with a wind speed standard, and works both through the land use permitting process and with local utility providers to reduce the hazard presented by falling trees. High winds are also responsible for damage through coastal flooding; therefore, the proposed mitigation actions previously described for coastal flooding should also be considered as mitigation actions for windstorms.

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, the proposed mitigation actions for windstorms and tornadoes (windstorm/tornado action [WTA]) are summarized in Table 6.5. The windstorm and tornado mitigation strategy remained unchanged during the 2010 and 2015 updates.

Table 6.5 Proposed Windstorm and Tornado Mitigation Actions

WTA1	
Continue to develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.	
Ideas for Implementation:	
<ul style="list-style-type: none"> • Collect, design, and disseminate useful education information to property owners to reduce risk from falling trees to life, property, and utility systems; • Develop partnerships with utility providers to document known hazard areas and implement actions to ensure timely response; and • Identify potentially hazardous trees and either remove or prune to reduce the hazard. 	
Coordinating Organization:	Planning and Public Works Department, Natural Resources Department
Timeline:	Ongoing
Plan Goals Addressed:	Emergency Services, Public Health and Safety, Develop Partnerships
Funding:	Tribal
WTA2	
Enhance strategies for debris management after windstorm events.	
Ideas for Implementation:	
<ul style="list-style-type: none"> • Develop coordinated management strategies for clearing roads of fallen trees and clearing debris from public and private property. 	
Coordinating Organization:	Planning and Public Works, Natural Resources, and Police departments
Timeline:	Ongoing
Plan Goals Addressed:	Emergency Services, Develop Partnerships
Funding:	Tribal, External
WTA3	
Support/encourage electrical utilities to use underground construction methods where possible to reduce power hazards and outages from windstorms.	
Ideas for Implementation:	
<ul style="list-style-type: none"> • Increase the use of underground utilities where possible; and • Develop local utility to ensure timely response and repair. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Public Health and Safety, Develop Partnerships
Funding:	External
WTA4	
Increase public awareness of windstorm mitigation activities.	
Ideas for Implementation:	
<ul style="list-style-type: none"> • Provide public education materials for protecting life, property, and the environment from windstorm events; and • Distribute educational materials to Reservation residents and public and private sector organizations regarding preparedness for loss of power. 	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Increase Public Awareness, Protect Life and Property
Funding:	Tribal, External

6.2.6. Coastal Erosion

Coastal erosion has historically been addressed most often through structural means (e.g., bulkheads), which has sometimes exacerbated the problem by increasing erosion in front of or adjacent to the structure, such as can be seen along the Sandy Point Peninsula.

6.2.6.1. Current Coastal Erosion Mitigation Actions

The following actions are currently implemented to mitigate the hazards associated with coastal erosion:

- The Lummi Shore Road project, with its associated beach nourishment effort, stabilized the shoreline bluffs of the Lummi Peninsula along Bellingham Bay.
- Ongoing physical monitoring of the Reservation shorelines will detect existing problems and help to anticipate future problems.
- Review of land use permit applications by the Technical Review Committee provides an opportunity to direct new development away from vulnerable areas.
- In 2006, a section of Lummi View Drive near the tombolo to Portage Island was moved inland and away from the shoreline.
- In 2006, one structure was purchased and removed from the west side of the Sandy Point Peninsula through a FEMA PDM-C project grant, the Sandy Point Coastal Acquisition Project.
- In 2010, another structure was purchased and removed from the Sandy Point Peninsula through FEMA's Hazard Mitigation Grant Program (HMGP).

6.2.6.2. Proposed Coastal Erosion Mitigation Actions

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, as well as the mitigation actions for coastal flooding (Section 6.2.2) and landslides (Section 6.2.9), the proposed coastal erosion mitigation actions (coastal erosion action [CEA]) are summarized in Table 6.6. The coastal erosion mitigation strategy remained unchanged during the 2010 and 2015 updates.

Table 6.6 Proposed Coastal Erosion Mitigation Actions

CEA1	
Continue monitoring erosion rates along the Reservation shorelines.	
Ideas for Implementation:	
<ul style="list-style-type: none">• Complete evaluations of all Reservation shorelines and monitor eroding reaches to gain understanding of the processes generating the erosion.	
Coordinating Organization:	Natural Resources Department – Water Resources Division, Planning and Public Works Department
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Protect Natural Resources, Increase Public Awareness
Funding:	Tribal, External

Table 6.6 Proposed Coastal Erosion Mitigation Actions

CEA2	
Redirect and/or relocate development away from eroding shorelines.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Regulate construction near the shoreline under the existing Land Use, Zoning, and Development Code (LCL Title 15), Coastal Zone Management Plan (CZMP), and Flood Damage Prevention Code (LCL Title 15A). 	
Coordinating Organization:	Planning and Public Works Department, Natural Resources Department
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Protect Natural Resources, Increase Public Awareness
Funding:	Tribal, External
CEA3	
Develop appropriate shoreline defense works to protect vulnerable coastlines and high erosion areas containing cultural, economic, or natural resources.	
Coordinating Organization:	Planning and Public Works Department, Natural Resources Department
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Protect Natural Resources Protect Cultural Resources, Protect Economic Resources
Funding:	Tribal, External

6.2.7. Drought

Historically, the impact of drought on domestic and municipal water supplies was typically corrected by building another reservoir, a larger pipeline, a new well, or some other facility. Short-term measures, such as using large capacity water tankers to supply domestic potable water, have also been used.

6.2.7.1. Current Drought Mitigation Actions

Efficient water resource management can reduce the damages that may otherwise result from a drought. Drought information collection assists in the response to a drought and in the formulation of programs for future droughts. Drought forecasting information and mitigation strategies used in Washington State that may influence the effects of a drought on the Reservation include (WEMD 2001):

- Irrigation before a forecasted drought
- Advance warning of changes in streamflow
- Measurement of snow pack conditions
- Limit irrigation
- Study of groundwater supplies
- Shutdown of logging operations
- Water conservation measures
- Reduce hydroelectric power use
- Voluntary water and energy conservation programs

- Purchase of out-of-region energy
- Apply for federal drought relief programs
- Washington State drought legislation
- Consider emergency supplemental groundwater permits

The Lummi Water Resources Division (LWRD) of the Lummi Natural Resources Department has an ongoing groundwater monitoring program that tracks water levels in Reservation aquifers. This effort is improving the understanding of water resources on the Reservation and will help manage potential water shortages in the future. In addition, the LWRD developed a Lummi Nation Water Conservation Plan in 2004 that includes actions applicable to reducing drought effects. The Water Resources Protection Code (LCL Title 17) regulates water allocation in times of water shortage (Section 17.03.010 (d)).

At the regional level, the Lummi Nation participated in the development and adoption of the Water Resources Inventory Area 1 (WRIA 1) Watershed Management Plan and the associated Instream Flow Action Plan. This regional water resources management effort should mitigate the impacts of droughts on the Reservation and the impacts to the natural resources that the Lummi People rely on.

6.2.7.2. Proposed Drought Mitigation Actions

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, the proposed drought mitigation actions (drought action [DA]) are provided in Table 6.7. The drought mitigation strategy remained unchanged during the 2010 and 2015 updates.

Table 6.7 Proposed Drought Mitigation Actions

DA1	
Implement the mitigation actions recommended in the Lummi Nation Water Conservation Plan, both before and after drought conditions occur.	
Coordinating Organization:	Lummi Tribal Sewer and Water District, Natural Resources Department – Water Resources Division
Timeline:	Ongoing
Plan Goals Addressed:	Protect Natural Resources, Protect Economic Resources
Funding:	Tribal, External
DA2	
Protect the senior water rights of the Lummi Nation in the Nooksack River watershed.	
Coordinating Organization:	Lummi Indian Business Council, Natural Resources Department
Timeline:	Ongoing
Plan Goals Addressed:	Protect Natural Resources, Protect Economic Resources
Funding:	Tribal

6.2.8. Wildfire

The following mitigation actions address wildfires on the Lummi Indian Reservation.

6.2.8.1. Current Wildfire Mitigation Actions

The following actions are currently implemented to mitigate the hazards associated with wildfire on the Reservation:

- In coordination with the Lummi Natural Resources Department (LNR) Forestry Manager, the LNR Executive Director issues a burn ban that prohibits open burning when conditions are dry.
- Fire hydrants and sufficient water storage and pressure are maintained in developed areas, although some isolated homes are too far from hydrants for them to be used.
- There are three fire stations on the Reservation (Gooseberry Point, Sandy Point Heights, Sandy Point), one each in the two developed forested areas of the Reservation (Lummi Peninsula, Northwest Upland).
- In 2006, the LNR Forestry Division purchased a gas powered pump, fireline hose, four backpack water pumps, fireline hand tools, and personal protective equipment for wildland firefighting (Deweese 2007).
- Between 2007 and 2010, the LNR Forestry Division purchased a Ford F-450 flat bed truck, a 20 foot trailer, a 725 gallon water tank, a BB-4 fire pump, 1,000 feet of firehose, 4 bladder bags, 4 fire rakes, 4 Pulaskis, and 4 shovels, as well as multiple pairs of fire pants and shirts, water bottles, helmets, and fire shelters (Deweese 2010).
- The LNR Forestry Division updated the Lummi Nation Forest Management Plan in 2011, issues burning permits, and distributes a wildfire brochure for public education.

6.2.8.2. Proposed Wildfire Mitigation Actions

Building within the urban-wildland interface, particularly when there is minimal attention paid to the need for fire protection, increases the potential for structure damages from wildfires. To address this problem, public education about reducing hazards from wildfires and planning escape routes is necessary, as proper planning, maintenance, and early-warning systems are essential to saving lives and protecting property. There are a number mitigation activities that can be utilized to minimize injury and property loss from wildfires, including (WEMD 2001):

- Develop ordinances and educate people regarding wildfire risks and mitigation measures
- Develop fire detection programs and emergency communications systems
- Exercise warning systems and evacuation plans
- Road closures during fires
- Woodland property owner precautions:
 - Maintain appropriate defensible space around homes
 - Provide access routes and turnarounds for emergency equipment
 - Minimize fuel hazards adjacent to homes
 - Use fire-resistant roofing materials

- Maintain water supplies
- Ensure that home address is visible to first responders

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, the proposed wildfire mitigation actions (wildfire action [WA]) are summarized in Table 6.8. The wildfire mitigation strategy remained unchanged during the 2010 and 2015 updates.

Table 6.8 Proposed Wildfire Mitigation Actions

WFA1	
Educate LIBC personnel on federal cost-share and grant programs, Fire Protection Agreements, and other related federal programs so the full array of assistance available is understood.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Investigate potential funding opportunities for individual mitigation projects; • Develop, approve, and promote Fire Protection Agreements and partnerships to clarify roles and responsibilities and to provide for fire mitigation activities and suppression preparedness; and • Ensure adequate water storage to meet increasing demands for water. 	
Coordinating Organization:	Multi-Hazard Mitigation Team, Accounting Department, Lummi Tribal Sewer and Water District
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness
Funding:	Tribal
WFA2	
Inventory alternative firefighting water sources and encourage the development of additional sources.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Advocate for water storage facilities with fire-resistant electrical pump systems in developments outside of fire protection districts that are not connected to community water or hydrant systems; and • Develop a protocol for fire jurisdictions and water districts to communicate all hydrant outages and water shortage information. 	
Coordinating Organization:	Multi-Hazard Mitigation Team, Lummi Tribal Sewer and Water District, Lummi Planning and Public Works Department
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property
Funding:	Tribal

Table 6.8 Proposed Wildfire Mitigation Actions

WFA3	
Enhance outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of citizens, public agencies, private property, and businesses to wildfire.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Visit neighborhoods and rural areas and conduct education and outreach activities; • Conduct specific community-based demonstration projects of fire prevention and mitigation in the urban-wildland interface; • Establish neighborhood “drive-through” activities that pinpoint site-specific mitigation activities – fire crews can give property owners personal suggestions and assistance; and • Perform public outreach and information activities at Reservation fire stations by creating “Wildfire Awareness Week” activities. Fire stations can hold open houses and allow the public to visit, see the equipment, and discuss wildfire mitigation with the station crews. 	
Coordinating Organization:	Multi-Hazard Mitigation Team, Individual Fire Departments
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness
Funding:	Tribal, External
WFA4	
Continue to increase communication, coordination, and collaboration between urban-wildland interface property owners, tribal planners, and fire prevention crews and officials to address risks, existing mitigation measures, and federal assistance programs.	
<p>Ideas for Implementation:</p> <ul style="list-style-type: none"> • Encourage families to have fire plans and practice evacuation routes; • Encourage fire inspections in residential homes by fire departments to increase awareness among homeowners and potential fire responders; • Require fire department notification of new business applications to ensure that appropriate fire plans have been developed; • Work closely with landowners and/or developers who choose to build in the urban-wildland interface to identify and mitigate conditions that aggravate urban-wildland interface wildfire hazards, including: <ul style="list-style-type: none"> ○ Ensure the width and grade of roadways is adequate to provide access for emergency equipment; ○ Ensure adequate water supplies; ○ Ensure adequate fuel breaks and a defensible space through the spacing, consistency, and species of vegetation around structures; ○ Avoid highly flammable construction materials; ○ Ensure building lots and subdivisions are in compliance with tribal land use/fire protection regulations – includes ensuring adequate entry/escape routes; ○ Encourage all new homes and major remodels involving roofs or additions that are located in the interface to have fire-resistant roofs and residential sprinkler systems. 	
Coordinating Organization:	Multi-Hazard Mitigation Team, Individual Fire Departments
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness, Emergency Services, Develop Partnerships
Funding:	Tribal, External

Table 6.8 Proposed Wildfire Mitigation Actions

WFA5	
Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.	
Ideas for Implementation:	
<ul style="list-style-type: none">• Employ mechanical thinning and prescribed burning to abate the risk of catastrophic fire and restore the more natural regime of higher frequency, low-intensity burns – prescribed burning can provide benefit to ecosystems by thinning hazardous vegetation and restoring ecological diversity to areas homogenized by invasive plants; and• Clear trimmings, trees, brush, and other debris completely from sites when performing routine maintenance and landscaping to reduce fire risk.	
Coordinating Organization:	Multi-Hazard Mitigation Team, Lummi Natural Resources Department – Forestry Division, Individual Fire Departments
Timeline:	Ongoing
Plan Goals Addressed:	Protect Environmental Resources
Funding:	Tribal

6.2.9. Landslide

The following mitigation actions are applicable to landslide hazards on the Reservation.

6.2.9.1. Current Landslide Mitigation Actions

Several landslide mitigation actions are implemented on the Reservation:

- Monitoring of coastal erosion to provide information on shoreline areas susceptible to future landslides.
- Review of land use permit applications by the Technical Review Committee (TRC) provides an opportunity to reduce erosion and loading of slopes by improper drainage.
- Use of high-resolution digital elevation models (e.g., LIDAR) to refine mapping of landslide hazard areas.

6.2.9.2. Proposed Landslide Mitigation Actions

Landslide hazards are often compounded by poor land use management practices. Applying established ordinances where geologically hazardous areas have been identified will prevent some landslide losses. However, the Reservation already has several residential areas with homes that are above or below unstable slopes. Careful maintenance of vegetation on slopes, prevention of erosion, engineered drainage of slopes, and other mitigation using qualified expertise is necessary to protect these areas.

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, the proposed landslide mitigation actions (landslide action [LSA]) are summarized in Table 6.9. The landslide mitigation strategy remained unchanged during the 2010 and 2015 updates.

Table 6.9 Proposed Landslide Mitigation Actions

LSA1	
Continue to improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in landslide-prone areas.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Develop public information to emphasize economic risk when building on potential or historical landslide areas. 	
Coordinating Organization:	Multi-Hazard Mitigation Team, Technical Review Committee, Natural Resources and Planning and Public Works departments
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness
Funding:	Tribal, External
LSA2	
Encourage construction and subdivision design that can be applied to sloped areas to reduce development effects on landslide vulnerability.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Increase communication and coordination between the Lummi Planning and Public Works Department divisions and developers. 	
Coordinating Organization:	Technical Review Committee
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Develop Partnerships
Funding:	Tribal
LSA3	
Limit construction in identified potential and historical landslide areas through regulation and public outreach.	
Ideas for Implementation:	
<ul style="list-style-type: none"> Analyze existing regulations regarding development in landslide-prone areas; Continue to use land use permitting process to review proposed projects in potential landslide areas; Conduct public outreach through appropriate channels (e.g., neighborhood associations, Squol Quol). 	
Coordinating Organization:	Multi-Hazard Mitigation Team, Technical Review Committee
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness, Protect Environmental Resources
Funding:	Tribal, External

6.2.10. Tsunami

The following mitigation actions apply to tsunami hazards on the Reservation.

6.2.10.1. Current Tsunami Mitigation Actions

Current tsunami mitigation actions on the Reservation include:

- Adoption and implementation of the Flood Damage Prevention Code (LCL Title 15A).
- Improvement of the Lummi Bay seawall.

- Installation of three All-Hazard Alert Broadcast (AHAB) towers (tsunami warning systems) on the Reservation:
 - The purchase of one system for the Sandy Point Peninsula by Washington State and Phillips 66 (previously ConocoPhillips) was coordinated by Whatcom County.
 - Two additional systems were purchased by the Lummi Nation through an Emergency Management Preparedness Assistance Grant from Washington State and were installed in 2007.
- Development of tsunami evacuation route maps and brochures for the Reservation in coordination with Washington State (Appendix F).
- Installation of warning signs and tsunami evacuation route signs in fall 2009 by the Lummi Natural Resources Department in coordination with Washington State and Whatcom County.
- Two structures have been purchased and removed from the west side of the Sandy Point Peninsula, in an area modeled to have a 0.5 to 2.0 meter inundation from a tsunami generated by a Cascadia Subduction Zone earthquake.

With the installation of the AHAB towers and the tsunami evacuation route signs and the distribution of the tsunami brochures, the former Short-Term Tsunami Mitigation Action No. 1 was completed; this action is therefore no longer listed under the proposed mitigation actions.

6.2.10.2. Proposed Tsunami Mitigation Actions

The tsunami hazard on the Reservation is similar in nature, but potentially much larger in scale, than the hazard associated with coastal flooding. Accordingly, the previously identified coastal flooding mitigation actions also apply to the tsunami hazard. In particular, discouraging further development in tsunami hazard zones and encouraging the acquisition and relocation of vulnerable properties are important undertakings. However, relocation may be difficult to implement because many owners may be reluctant to move. Public education efforts will therefore be important to reduce the public health and safety hazard.

In addition to the mitigation measures identified in Section 6.2.1 – All Hazards, the proposed tsunami mitigation actions (tsunami action [TA]) are summarized in Table 6.10. The former Short-Term Tsunami Mitigation Action 1 was completed during 2007-2010 and the mitigation action was moved from proposed to current mitigation actions in the 2010 update. Also in the 2010 update, the former Tsunami Long-Term Mitigation Action 1 was combined with Flood Action 9 and is discussed in Section 6.2.2.

Table 6.10 Proposed Tsunami Mitigation Actions

TA1	
Provide residents in the hazard area with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami – after installation of the AHABs and distribution of the brochures, this action should be continued through additional mailings and public meetings.	
Coordinating Organization:	Multi-Hazard Mitigation Team
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness
Funding:	Tribal, External
TA2	
Continue to operate and maintain the AHAB towers, including weekly testing to ensure that they are activated when needed.	
Coordinating Organization:	Multi-Hazard Mitigation Team, Police Department
Timeline:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Increase Public Awareness
Funding:	Tribal, External

6.2.11. Volcano

Preparedness and land use planning are important for mitigation of volcanic hazards. Reducing development in lahar paths, implementing warning systems, and planning evacuations can lower the potential loss of life and property during future volcanic events.

6.2.11.1. Current Volcano Mitigation Actions

Federal, tribal, state, and local governments have developed the Mount Baker/Glacier Peak Coordination Plan (2012) to coordinate emergency preparedness, response, and recovery efforts between governmental agencies if volcanic activity occurs at Mount Baker or Glacier Peak. In June 2014, Lummi Water Resources Division staff attended the Mount Baker/Glacier Peak Tabletop Exercise at the Whatcom County Emergency Operations Center to test the plan and provided written comments to be incorporated into the plan update that is currently underway (completion expected in 2015/2016).

Current mitigation actions at Mount Baker include the following:

- Continuous monitoring of the areas around Mount Baker by the Pacific Northwest Seismic Network, which is jointly operated by the University of Washington and the U.S. Geological Survey (USGS). The first indications of volcanic unrest at Mount Baker will likely be an increase in earthquake activity, and it will likely take days to weeks to decide whether or not the increase in earthquake activity is the result of magma movement towards the surface.
- In response to developing volcanic activity, a USGS response team expects to:
 - Establish a temporary volcano observatory at or near an Emergency Operations Center in Whatcom or Skagit counties. The observatory will maintain close contact with emergency managers and will be sited to allow efficient daily helicopter access to the volcano. The primary function of the USGS response

team is to monitor all volcanic developments and provide eruption forecasts and hazard assessment information to support decisions by public officials.

- Install monitoring instruments to collect and analyze visual, seismic, lahar detection, deformation, and gas emission data. As an important element of redundancy, critical seismic data will be received and analyzed both at the University of Washington and the local temporary volcano observatory.
- In the event of volcanic unrest, the Whatcom County Division of Emergency Management may activate and maintain Whatcom County Emergency Operations Center.

6.2.11.2. Proposed Volcano Mitigation Actions

For a variety of reasons, hazardous magmatic eruptions at Mount Baker will probably be preceded by weeks or more of activity. In addition, a lahar, which is the most significant volcanic hazard that may affect the Reservation, would most likely take several hours to reach the Reservation. The AHAB warning towers could be locally activated to ensure floodplain residents are aware of the lahar threat and have sufficient time to evacuate if needed. By the time it reached the Reservation, the impacts of a lahar would be similar to that of a Nooksack River flood; therefore, the proposed mitigation actions for volcanic lahars are the same as described for Nooksack River flooding in Section 6.2.2.2.

6.2.12. Mitigation Actions and Cultural Resources

The cultural resources of the Lummi Nation are located throughout the Reservation, the Lummi Nation's usual and accustomed (U&A) grounds and stations, and Lummi Traditional Territories. Cultural Resources are administered and protected in accordance with the Cultural Resources Preservation Code (LCL Title 40). The Cultural Resources Department, which is also the designated Lummi Nation Tribal Historic Preservation Office (THPO), is responsible for guiding the identification, preservation, stabilization, improvement, restoration, and maintenance of historical and cultural resource properties. Cultural Resources Department staff has largely concentrated their efforts on protecting cultural resources affected by new development or changes in land use; there is currently no formal policy addressing the threat of natural hazards to cultural resources. All Hazards Action 18 (AH18), which proposes the development of a formal natural hazards cultural resources protection strategy, was added to the mitigation strategy during the 2010 MHMP update. Additionally, the Cultural Resources Department Director was added to the Multi-Hazard Mitigation Team with the adoption of the 2010 MHMP update.

6.2.13. Summary of Recommended Mitigation Actions

Table 6.11 summarizes the Lummi Nation's identified mitigation actions and priorities for natural hazards occurring on the Reservation.

Table 6.11 Summary of Recommended Mitigation Actions and Priorities (Highlighted Red) by Hazard

Hazard	Action	Activity	Progress
All Hazards	AH1	Establish the formal goal of becoming a disaster-resistant community, including objectives or benchmarks for preparedness.	
	AH2	Maintain the established Multi-Hazard Mitigation Team comprised of representatives from pertinent LIBC departments and other organizations on the Reservation.	The MHMT was established in 2004 by LIBC Resolution No. 2004-015 and reauthorized by Resolution No. 2007-060, Resolution No. 2010-093, and Resolution No. 2015-107.
	AH3	Establish an Emergency Management Division within the Lummi Nation Police Department and hire an Emergency Manager.	
	AH4	Maintain the posting of this plan, including updated versions, on the Lummi Nation website, and add links to further hazard mitigation information (e.g., DisasterHelp.gov, FloodSmart.gov) as time and resources permit.	MHMP is posted on the Lummi website (www.lummi-nsn.gov) and will be replaced with adopted and approved update.
	AH5	Implement, maintain, and update the Lummi Nation Comprehensive Emergency Management Plan (CEMP).	CEMP (2006) adopted by LIBC Resolution No. 2006-036, updated CEMP (2015) adopted by LIBC Resolution No. 2015-086.
	AH6	Continue to implement and maintain the Lummi Nation Spill Prevention and Response Plan through government-wide preparedness (e.g., Incident Command System [ICS] and National Incident Management System [NIMS] training), and safety and response training, and coordination with area industries.	Spill Prevention and Response Plan completed in 2005, training and spill drills are ongoing.
	AH7	Continue to coordinate LIBC emergency response efforts, as appropriate, with those of Whatcom County and other federal, state, and local agencies.	Coordination has occurred through flood event responses, tsunami warning system purchases, tsunami evacuation route map development, and oil spill response drills.
	AH8	Establish 24-hour emergency medical response capability (an equipped Medic 1 unit along with paramedics and emergency medical technicians) located on the Reservation.	
	AH9	Further promote the establishment and maintenance of home survival/emergency kits.	Public information has been provided through community education and outreach events (e.g., Hazard Fair, Safe Streets Walks) and materials (Squol Quol articles, brochures, websites).
	AH10	Purchase, or make available for purchase, 9-1-1 house number signs for all addressed structures on the Reservation to aid emergency responders.	GIS layer of addressed structures was developed in 2006 and is updated annually. 9-1-1 house number signs installed at approximately 820 tribal member owned homes on the Lummi Peninsula in 2013.

Table 6.11 Summary of Recommended Mitigation Actions and Priorities (Highlighted Red) by Hazard

Hazard	Action	Activity	Progress
	AH11	Continue to pursue funding for the Lummi Nation mitigation priorities and recommendations described below, including funding for needed staff and infrastructure.	Three Pre-Disaster Mitigation (PDM) subgrant projects funded (Slater Road Elevation, Sandy Point Coastal Acquisition, and Project Management Costs). One Emergency Management Preparedness Assistance Grant (EMPAG) grant for tsunami warning systems.
	AH12	Promote a disaster and hazard mitigation fund to assist the mitigation and response efforts of individuals and organizations on the Reservation.	
	AH13	Improve and sustain public information and education programs aimed at mitigating natural hazards.	Public information has been provided through community education and outreach events (e.g., Hazard Fair, Safe Streets Walks) and materials (Squol Quol articles, brochures, websites). Lummi Nation CERT established in 2004.
	AH14	Develop capability to use HAZUS Multi-Hazard (HAZUS-MH) software and Benefit-Cost Analysis (BCA) software.	Water Resources Division staff members have received training and have used BCA software.
	AH15	Provide Community Emergency Response Team (CERT) training to all residents on the Reservation.	Lummi Nation CERT established in 2004. CERT training provided in 2012.
	AH16	Expand the emergency warning capabilities on the Reservation beyond the All-Hazard Alert Broadcast (AHAB) towers through a geographically-specific alert system that alerts personal devices (e.g., cell phones).	LIBC Emergency Notification Text Messaging System implemented in 2014.
	AH17	Develop a formal cultural resources protection strategy.	
	AH18	Develop a Post-Disaster Management Plan.	
Floods	FA1	Identify funding to complete elevation certificates for pre-FIRM tribal residences and businesses located in the floodplain.	
	FA2	Identify funding to purchase flood insurance for LIBC buildings in or adjacent to the floodplain.	All LIBC owned structures in Special Flood Hazard Areas (SFHAs) have flood insurance. Silver Reef Hotel, Casino & Spa has flood insurance.
	FA3	Obtain funding for construction of 100-year levee along Ferndale Road.	
	FA4	Obtain funding for raising Slater Road and providing for underflow.	Received 2005 Pre-Disaster Mitigation (PDM) grant for this project, but project was not completed due to higher than anticipated costs. Additional funding needs to be secured.
	FA5	Obtain funding for construction and maintenance of a new culvert from the Nooksack River to the Lummi River.	
	FA6	Monitor condition of culverts, tide gates, and seawall and identify funding sources for potential maintenance or repairs	

Table 6.11 Summary of Recommended Mitigation Actions and Priorities (Highlighted Red) by Hazard

Hazard	Action	Activity	Progress
	FA7	Obtain funding for raising Haxton Way and providing for underflow.	
	FA8	After modeling of Nooksack River flooding is completed by Whatcom County, analyze flood levels under future conditions of land use and assess the benefits of more protective development standards.	
	FA9	Enforce the provisions of Title 15A for new development in the coastal floodplain and continue to pursue acquisitions of existing vulnerable structures.	Implementation of Title 15A was strengthened through three FEMA Community Assisted Visits (CAVs). Two houses on the Sandy Point Peninsula acquired and removed.
Earthquakes	EA1	Encourage seismic strength evaluations of critical facilities on the Reservation to identify vulnerabilities and implement mitigation measures necessary to meet current seismic standards.	
	EA2	Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.	
	EA3	Encourage purchase of earthquake hazard insurance.	
	EA4	Encourage reduction of non-structural and structural earthquake hazards in homes, schools, businesses, and government offices.	
Severe Winter Storms	WSA1	Enhance strategies for debris management for severe winter storm events.	
	WSA2	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public and private infrastructure from severe winter storms.	
	WSA3	Increase public awareness of severe winter storm mitigation measures.	Public information provided through community education and outreach events and materials and formation of the Lummi Nation CERT.
Windstorms and Tornadoes	WTA1	Continue to develop and implement programs to keep trees from threatening lives, property, and public infrastructures during windstorm events.	Forestry Manager addresses by expediting hazard tree permits.
	WTA2	Enhance strategies for debris management after windstorms.	
	WTA3	Support/encourage electrical utilities to use underground construction methods where possible to reduce power hazards and outages from windstorms.	Lummi Nation School, Wex'li'em (Community Building), and two well sites have underground power lines.
	WTA4	Increase public awareness of windstorm activities.	Public information provided through community education and outreach events and materials and formation of the Lummi Nation CERT.
Coastal Erosion	CEA1	Continue monitoring of erosion rates along Reservation shorelines.	Monitoring continued through 2015 (contracted through Coastal Geologic Services, Inc.).

Table 6.11 Summary of Recommended Mitigation Actions and Priorities (Highlighted Red) by Hazard

Hazard	Action	Activity	Progress
	CEA2	Redirect and/or relocate development away from eroding shorelines.	Two structures removed from the Sandy Point Peninsula, section of Lummi View Drive moved inland.
	CEA3	Develop appropriate shoreline defense works to protect vulnerable coastlines and high erosion areas containing cultural, economic, or natural resources.	
Drought	DA1	Implement the mitigation actions recommended in the Lummi Nation Water Conservation Plan, both before and after drought conditions occur.	Development of water facilities plan.
	DA2	Protect the senior water rights of the Lummi Nation in the Nooksack River watershed.	Adoption of Water Resources Inventory Area 1 (WRIA 1) Watershed Management Plan and Instream Flow/Fish Habitat Plan.
Wildfire	WFA1	Educate LIBC personnel on federal cost-share and grant programs, Fire Protection Agreements, and other related federal programs so the full array of assistance available is understood.	Forestry Division receives BIA funding, has purchased firefighting equipment, and participates in firefighting trainings.
	WFA2	Inventory alternative firefighting water sources and encourage the development of additional sources.	
	WFA3	Enhance outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of citizens, public agencies, private property, and businesses to wildfire.	Forestry Division distributes a wildfire brochure and imposes burn bans.
	WFA4	Continue to increase communication, coordination, and collaboration between urban-wildland interface property owners, tribal planners, and fire prevention crews and officials to address risks, existing mitigation measures, and federal assistance programs.	
	WFA5	Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.	The Lummi Nation Forest Management Plan was updated in 2011.
Landslide	LSA1	Continue to improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in landslide-prone areas.	Landslide-prone areas refined using LIDAR elevation model.
	LSA2	Encourage construction and subdivision design that can be applied to sloped areas to reduce development effects on landslide vulnerability.	
	LSA3	Limit construction in identified potential and historical landslide areas through regulation and public outreach.	Implemented through Technical Review Committee and improved through use of LIDAR elevation model.
Tsunami	TA1	Provide residents in the hazard area with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami – after installation of the AHABs and distribution of the brochures, this action should be continued through additional mailings and public meetings.	Public information has been provided through community education and outreach events (e.g., Hazard Fair, Safe Streets Walks) and materials (Squol Quol articles, brochures, websites).

Table 6.11 Summary of Recommended Mitigation Actions and Priorities (Highlighted Red) by Hazard

Hazard	Action	Activity	Progress
	TA2	Continue to operate and maintain the AHAB towers, including weekly testing to ensure that they are activated when needed.	Towers are tested weekly by the Police Department.
Volcano		Mitigation actions for lahars are the same as for Nooksack River flooding.	

6.3. Mitigation Priorities

A ranking system was used by the Multi-Hazard Mitigation Team (MHMT) to prioritize actions and associated mitigation projects. The ranking system includes the following criteria:

1. Reduction of threats to public health and safety
2. Reduction of potential structural damages
3. Reduction of potential economic losses
4. Effects on environmental and cultural resources
5. Alignment with MHMP goals and objectives
6. Benefit/cost ratio of the project

Since most hazard mitigation funding from federal and state sources requires a benefit/cost ratio greater than one, this ratio is an important factor in the assessment of mitigation projects. Unless a project involves overriding public health and safety or cultural factors, the MHMT will only consider projects in which project benefits at least exceed project costs. In seeking to maximize public benefits, the MHMT will acquire the information and/or assistance necessary to determine the best possible benefit-cost ratio for high priority projects before submitting applications for these projects to funding agencies. Projects that are recommended for funding will be those that have a well documented ability to reduce future impacts of natural disasters, as well as demonstrate cost-effectiveness through a benefit-cost review. It is anticipated that projects addressing the multiple high vulnerabilities of the Sandy Point Peninsula, Floodplain, and Gooseberry Point assessment areas will be top priority projects on the Reservation.

In addition to the hazard mitigation measures that have already been implemented, the following mitigation priorities have been identified by the MHMT. The mitigation priorities are also listed in Table 6.11 at the end of Section 6.2.

6.3.1. All Hazards

1. Establish an Emergency Management Division within the Lummi Nation Police Department and hire an Emergency Manager (at least 0.5 FTE).
2. Establish emergency medical response capability (an equipped Medic 1 unit along with paramedics and emergency medical technicians) located on the Reservation.
3. Purchase, or make available for purchase, 9-1-1 house number signs for all addressed structures on the Reservation to aid emergency responders.
4. Promote the establishment and maintenance of home survival/emergency kits.
5. Pursue funding for the Lummi Nation mitigation priorities and recommendations described in this MHMP, including funding for needed staff and infrastructure.
6. Improve and sustain public education programs aimed at mitigating natural hazards.
7. Redirect and/or relocate development away from hazard areas.
8. Encourage seismic strength evaluations of schools, public infrastructure, and critical facilities on the Reservation to identify vulnerabilities and help prioritize mitigation to meet current seismic standards.

9. Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.
10. Continue to develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.
11. Continue monitoring of erosion rates along the shorelines of the Reservation.
12. Limit construction in identified landslide areas through regulation and outreach.

6.3.2. Floods, Tsunamis, and Volcanic Lahars

The following are specific long-term flood, tsunami, and volcanic lahar mitigation priorities on the Reservation, listed in order of importance. Priorities 1-5 were adopted from the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a), while priorities 6-7 were developed specifically for this MHMP. The locations of the specific priorities are shown in Figure 6.1.

1. Protect the Nooksack River floodplain on the Reservation and maintain access to the Lummi Peninsula by constructing a 100-year setback levee that extends along Ferndale Road from Ferndale to Kwina Slough, then along the north side of Kwina Slough to Marine Drive, and finally along Marine Drive to Lummi Shore Road (the levee should include a bridge over the Lummi River channel and culverts allowing flow under Marine Drive).
2. Reduce the potential for flood damage along the low-lying coastal areas and concurrently reduce damage to shoreline resources by bulkheads through the acquisition or relocation of flood-prone structures currently located in the coastal velocity zones.
3. Complete the elevation of Slater Road to the 100-year flood level east of the Nooksack River including a bridge to allow floodwaters to pass downstream.
4. Protect, acquire, or relocate vulnerable structures in the coastal and riverine floodplains, outside of the velocity zone and floodway, respectively.
5. Provide access to the Lummi Peninsula in the case of levee failure by raising Haxton Way and providing for the flow of floodwaters under Haxton Way (this could serve as an interim measure prior to construction of a 100-year setback levee).
6. Purchase flood insurance for all LIBC structures within or adjacent to the floodplain.
7. Maintain the tsunami warning system and evacuation route signs in hazard areas and continue to provide residents in the tsunami hazard areas with updated information on the tsunami hazard, including the probability of occurrence, potential size of the hazard, signs of an impending tsunami, and best route to avoid a tsunami.

6.4. Action Plan

To meet the Lummi Nation's goals and objectives for hazard mitigation, the following actions were proposed in the 2007 MHMP, amended by the MHMT for the 2010 MHMP, and confirmed by the MHMT for the 2015 MHMP:

1. Establish a Lummi Nation Emergency Management Division within the Lummi Nation Police Department and hire an Emergency Manager.
2. Maintain the Multi-Hazard Mitigation Team composed of representatives from pertinent LIBC departments on the Reservation.
3. Continue to pursue funding for the Lummi Nation mitigation priorities and recommendations described in the 2015 Multi-Hazard Mitigation Plan, including funding for needed staff and infrastructure.
4. Finalize the Comprehensive Plan that is aligned with the provisions of the Land Use, Zoning, and Development Code; the Flood Damage Prevention Code; the Building Code; the Flood Damage Reduction Plan; the Coastal Zone Management Plan; the Water Resources Protection Code; Cultural Resources Preservation Code; other hazard-related ordinances; and the recommendations of this MHMP.
5. Coordinate hazard planning with other jurisdictions, as appropriate, and review any actions proposed for the Nooksack River and/or Lummi River watersheds that may affect flooding on the Reservation.
6. Review and possibly amend the Flood Damage Prevention Code (LCL Title 15A) in response to an analysis of future-conditions flood levels and flood management actions implemented throughout the Nooksack River watershed.
7. Maintain participation in the Community Rating System and take appropriate actions to earn additional points toward discounts of flood insurance premiums for residents of the Reservation.
8. Continue to review hazard maps for accuracy and any changes in the estimated vulnerability of the Reservation.
9. Coordinate LIBC emergency response efforts with other appropriate jurisdictions and agencies.
10. Continue implementation of a public education effort to inform residents of the potential natural hazards on the Reservation.

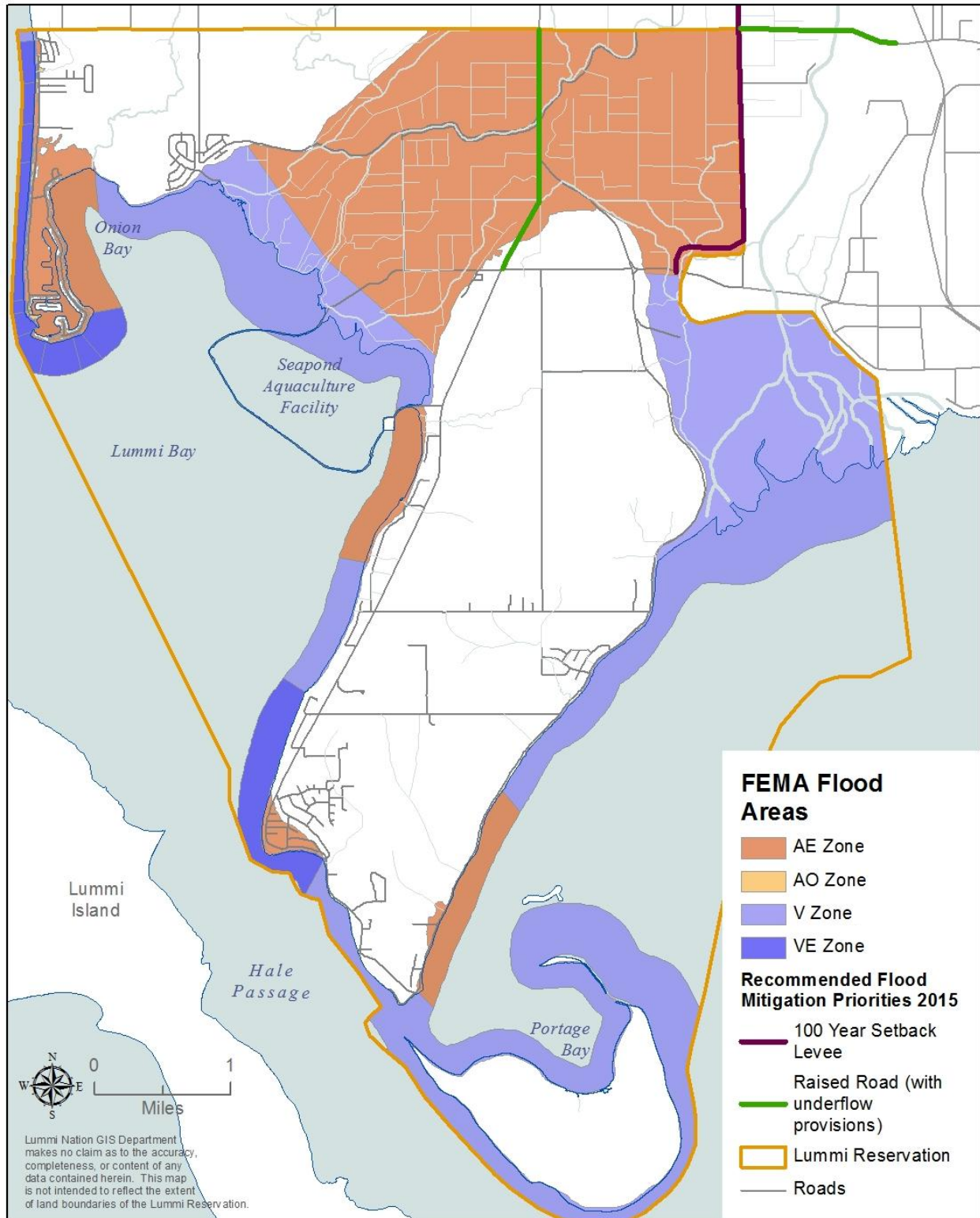


Figure 6.1 Locations of Recommended Flood Mitigation Priorities

6.5. Tribal Capability Assessment

This section presents the pre- and post-disaster hazard management policies, programs, and mitigation capabilities of the Lummi Nation and the other jurisdictions that provide support services to the Lummi Nation during disasters on the Lummi Indian Reservation. This discussion will include an evaluation of Lummi Nation laws, regulations, policies, and programs that are related to hazard mitigation and to development activity in hazard-prone areas. Funding capabilities for hazard mitigation projects are also addressed. This section also includes a general description and analysis of the mitigation policies, programs, and capabilities of local organizations on the Reservation (e.g., Lummi Tribal Sewer and Water District, Northwest Indian College, Lummi Nation School).

6.5.1. Tribal Capability Assessment

This section discusses LIBC land use plans and development regulations, flood damage prevention plans and policies, wildfire damage prevention plans and policies, and other LIBC hazard mitigation measures.

6.5.1.1. Land Use Plans and Development Regulations

Land use planning is a necessary and useful tool for addressing natural hazards. With land use planning and associated regulations, a jurisdiction is able to reduce future damages by controlling the density, location, construction, and type of development that occurs in a hazardous area. The Lummi Nation Planning and Public Works Department, Natural Resources Department, and Cultural Resources Department administer regulations that control development in environmentally sensitive and hazardous areas on the Reservation. Whatcom County has historically exerted permitting authority for fee lands (i.e., lands where property taxes are assessed and paid to the county) on the Reservation and permitted nearly all of the development that is currently located in the most hazardous areas on the Reservation.

As described in Section 4.2.3, the Lummi Nation is striving to reduce potential hazards by regulating where and how development occurs. The policies and regulations include:

- Natural Resources Code (Lummi Nation Code of Laws [LCL] Title 10)
- Tidelands Code (LCL Title 13)
- Land Use, Zoning, and Development Code (LCL Title 15)
- Flood Damage Prevention Code (LCL Title 15A)
- Water Resources Protection Code (LCL Title 17)
- Solid Waste Control and Disposal Code (LCL Title 18)
- Building Code (LCL Title 22)
- Cultural Resources Protection Code (LCL Title 40)
- Coastal Zone Management Plan

The current Building Code (LCL Title 22) adopts the Uniform Building Code by reference, which includes seismic design standards (the Reservation is in Seismic Zone 3) and wind design standards (the Wind Speed Area is 80 mph, with exposure factor B or C). These standards have

been in place since the Uniform Building Code was adopted by the Lummi Nation in 1975. The Lummi Building Code was amended in January 2004, primarily to update references to various uniform codes. The Lummi Nation plans to adopt the International Building Code in the near future.

As noted previously, there are approximately 38 miles of marine shoreline on the Reservation. The Lummi Coastal Zone Management Plan (CZMP) provides important guidance on development in the coastal zone, which is the location of the most serious hazard vulnerabilities on the Reservation. Originally adopted in 1979, an update to the CZMP is currently underway. The Lummi Nation Tidelands Ordinance (LCL Title 13) prohibits the construction of bulkheads on the Reservation unless specifically authorized by the LIBC.

The LIBC incorporated the environmental review and permitting provisions of a Tribal Environmental Policy Act (TEPA) into the Land Use, Zoning, and Development Code (LCL Title 15). These provisions formalize an environmental review process that has been functioning since it began in 1968 with the adoption of an interim zoning ordinance by the LIBC. The original Zoning Ordinance and other LIBC ordinances (e.g., the Tidelands Code, the Water Resources Protection Code, and the Coastal Zone Management Plan) initiated procedures for project review and permitting. Approval for projects came from the designated Lummi Planning and Public Works Department staff, unless the project appeared to be controversial. More controversial projects required approval by the Lummi Planning Commission.

To improve the permitting system, the Lummi Nation Technical Review Committee (TRC) was created in October 1996. The purpose of the TRC is to refine the LIBC environmental review capacity so that the Lummi Nation's goals related to resource protection and compliance with federal and tribal laws could be supported, while the development needs of Reservation landowners could also be met. In 1997, the LIBC charged the TRC with reviewing proposed land use activities on the Reservation and implementing tribal and federal laws to protect public and private resources. The TRC is composed of representatives from several departments of the LIBC and generally meets weekly to review proposed projects and to conduct site visits.

In early 1997, the TRC incorporated provisions of the National Environmental Policy Act (NEPA) into two revised permit applications, one for small projects and one for large projects. These applications are generally compatible with the environmental review checklist required off-Reservation under the Washington State Environmental Policy Act (SEPA). Completed permit applications are distributed to all department representatives. The representatives assemble comments for consideration at the weekly TRC meeting. At the TRC meeting, an application is either not approved pending further information, approved, approved with conditions, or denied.

The permit applications also help the TRC members determine if additional review is required pursuant to the NEPA or other federal laws. The TRC incorporated the basic aspects of the NEPA process into its review process, including an environmental checklist; the concept of avoiding, minimizing, and mitigating impacts; and the use of Environmental Assessments (EAs) or Environmental Impact Statements (EISs) to consider the effects of major projects. If it appears that a project will have a significant impact on natural or public resources and there is a federal nexus (e.g., federal permitting or federal funding), an EA or an EIS is required to comply

with the NEPA. Upon completion, the EA or EIS is evaluated by the TRC to determine project approval, conditioned approval, or denial (LWRD 1999). This environmental review process allows the TRC to ensure that the method and type of development that occurs in hazard areas is either not permitted or minimizes the potential for future damages. The modifications to LCL Title 15 adopted in January 2004 codifies the TRC and the NEPA provisions described above that previously had been authorized by an LIBC resolution (Resolution No. 97-104).

In 1968, the federal government began the National Flood Insurance Program (NFIP) as a way to limit future development in flood-prone areas and thereby prevent additional flood damages. The NFIP, which is administered by FEMA, qualifies residents of communities that adopt and administer minimum floodplain regulations for federally subsidized flood insurance. The Lummi Nation adopted floodplain regulations in 1997 in the form of the LCL Title 15A Flood Damage Prevention Code (see Appendix D). Following the adoption of LCL Title 15A, the Lummi Nation joined the NFIP on October 14, 1997. The NFIP Community Number for the Lummi Reservation is 530331. The Reservation moved from the emergency phase to the regular phase of the NFIP with the release of final Flood Insurance Rate Maps (FIRMs) and a Flood Insurance Study for the Reservation on January 16, 2004.

A NFIP Community Assistance Visit (CAV) was conducted for the Reservation by FEMA in 2005 and was successfully closed on April 28, 2005. The CAV improved the Lummi Nation's implementation of the National Flood Insurance Program through revisions to the Flood Damage Prevention Code, the creation of a Lummi Nation Floodplain Development Permit and associated application, and the development of a procedure for the issuance of permits for development in the floodplain. A second CAV during October 2007 recommended that the system for conducting floodplain determinations and ensuring compliance with Lummi Nation Floodplain Development Permit conditions be improved. This recommendation was addressed by changing practices so that permits are only issued after a pre-construction survey and the certificate of occupancy is only issued after receipt of the completed elevation certificate. The CAV also recommended the Lummi Nation Building Code be changed to add a requirement to display a 9-1-1 address sign. In 2012, a third Community Assistance Visit was conducted; no major changes to floodplain development regulations or permitting procedures were recommended.

In addition, the Lummi Nation joined the Community Rating System (CRS), which became effective on May 1, 2010. In the CRS, communities are rated by FEMA depending on the floodplain management practices that are implemented beyond the minimum mandated for membership in the NFIP and by public education efforts. If a community scores well in the CRS, then discounted flood insurance premiums are available to community members. In 2010, the Lummi Nation qualified as a Class 8 community, meaning that Reservation residents who purchased flood insurance using the Lummi Nation Community ID (No. 530331) received a 10 percent discount on policy premiums for property within the Special Flood Hazard Area (SFHA) and a 5 percent discount outside of the SFHA. Following the CRS Community Verification Visit in September 2013, the Lummi Nation's CRS rating improved to a Class 7, increasing the discount in the SFHA to 15 percent effective October 1, 2014.

The availability of flood insurance and regulation of development within the floodplain will help reduce overall damage and costs on the Reservation after future floods. In addition, by joining

the NFIP, the Lummi Nation is eligible to apply for state and federal grant programs to reduce flood hazards and repair flood damages. Further details on LCL Title 15A can be found in Section 5.4 and in the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a).

6.5.1.2. Flood Damage Reduction Plan Policies

An extensive list of policies recommended to guide floodplain, coastal, and watershed management activities are described in the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a), adopted by the LIBC in 2001 (LIBC Resolution No. 2001-131). These policies provide a set of operating principles to guide flood mitigation efforts over the long-term. The policies are divided into seven categories: general policies; floodplain land use; watershed management; flood mitigation projects; river channel maintenance; flood warning, information, education; and emergency response. These policies will help the Lummi Nation meet its goals and objectives for hazard mitigation. A summary of the policies is attached in Appendix E.

6.5.1.3. Wildfire Policies and Programs

The Natural Resources Code (LCL Title 10; first enacted March 6, 1964, last amended September 24, 2001) designated the Lummi Natural Resources Department (LNR) to be responsible for forest management on the Reservation. Chapter 10.18 (Forestry) of the Natural Resources Code established a forest practices review process, permit terms and conditions for forestry activities, and fire suppression authority for the LNR. The forestry chapter gave the LNR the authority to issue regulations governing burning on the Reservation during hazardous periods, including but not limited to:

- Issuing open burning bans.
- Requiring an open burning permit with conditions for fire protection.
- Providing requirements for safe burning.

The Lummi Nation Forest Management Plan (adopted in 2002; updated in 2011) supports a comprehensive program to manage the forest resources on the Reservation. The program requires or encourages management practices that will reduce the probability of wildfires on the Reservation.

6.5.1.4. All Hazards

The Lummi Indian Business Council has adopted the Lummi Nation Comprehensive Emergency Management Plan (adopted in 2006, updated in 2015) attached in Appendix C. The Comprehensive Emergency Management Plan (CEMP) coordinates with other plans and establishes procedures for LIBC departments to follow in case of an emergency. The Natural Resources Department has developed the Lummi Nation Spill Prevention and Response Plan (2005), which puts in place guidelines to direct LIBC actions in the event of a man-made disaster or oil spill. These plans instruct responsible officials and employees how to respond in order to minimize the effects of such a disaster.

Because property tax revenue from fee lands on the Reservation is currently paid to Whatcom County, the LIBC has limited revenue sources and generally has higher funding priorities than hazard mitigation. Outside funding is therefore necessary to implement mitigation projects that have significant costs. The Lummi Nation is eligible for and has received Hazard Mitigation

Grant Program funds when a disaster has been declared in Washington State. Other sources indirectly related to hazard mitigation, such as Economic Development Administration grants or Environmental Protection Agency grants, may help fund projects that have implications for hazard mitigation. In addition, the LIBC may be able to implement some inexpensive mitigation actions, such as public education, with current staffing. For example, the LIBC has a Communications Department that publishes a monthly community newspaper (Squol Quol) and provides community information through a cable news program and social media outlets. These and other media (e.g., newsletters, flyers, and telephone calls) have been used in the past and are currently used to provide public education or information to the community.

6.5.2. Local Public Organizations

The local public organizations on the Reservation (e.g., Lummi Tribal Sewer and Water District, Northwest Indian College, Lummi Nation School) are under the oversight of the LIBC and have limited scope and limited capabilities to respond to a disaster. These organizations are basically responsible for their own facilities and commonly need assistance to recover from a disaster. It is the intention of the Lummi Nation to provide leadership, guidance, and assistance to private citizens, businesses, and other Reservation organizations, both through the tribal capabilities described above and through the mitigation measures described in Section 6.2.

Since the adoption of this plan, the Natural Resources and Planning and Public Works departments have provided mitigation assistance to local organizations through:

- The Technical Review Committee's review of land use permit applications. This review results in the approval, approval with conditions, not approved pending further information, or denial of land use permit applications. Conditions placed on permits include requirements for siting, seismic strength, floodplain management, storm water management, and natural and cultural resources protection.
- Assistance to individuals, insurance agents, and government departments on floodplain determinations and floodplain development requirements.
- Provision of information to Reservation residents on floodplain hazard zones.
- Provision of information to Reservation residents on tsunami hazard zones.
- Coordinating and providing oil spill response training for Natural Resources Department staff.
- Public outreach through the community newspaper and television channel on personal emergency preparedness and specific hazard events.

6.5.3. Mitigation Capability Effectiveness

The plans and programs listed above to describe both tribal and local mitigation capability have been an effective starting point from which to mitigate the damage from natural hazards on the Reservation. As described above, the land use development codes and regulations limit development in hazardous areas, the permit review process ensures these codes and regulations are applied, and the plans describe policies and recommend activities for specific hazards (e.g., floods, oil spills) and general emergency management. This existing capability has been unified and significantly enhanced through the development and application of this Multi-Hazard Mitigation Plan. The implementation of the MHMP has greatly improved the tribe's hazard

mitigation efforts primarily through its resulting list of prioritized mitigation activities and the funding eligibility it creates. The development, implementation, and update of the plan have improved the awareness of the natural hazards on the Reservation and heightened the tribal government's awareness of the need and usefulness of mitigation activities.

The initial implementation of the MHMP has been effective in beginning to mitigate damage from natural hazards as shown through projects completed or begun over the history of the plan, including the acquisition of houses in the coastal flood areas and the purchase and installation of tsunami warning systems. For instance, the Sandy Point Coastal Acquisition project resulted in the purchase and removal of one home from the coastal V-Zone representing future avoided losses of \$2,654,163. A second structure on the Sandy Point Peninsula was acquired and removed in 2010 with Hazard Mitigation Grant Program funds. As another example, the three tsunami warning systems on the Reservation are able to reach approximately 1,240 commercial and residential structures. With an average household size of 3.66 persons and inclusion of average occupancy rates for the included commercial and public structures, approximately 6,500 people, approximately 3,000 of which are within the modeled inundation zones, would be notified of a tsunami or other hazard by these systems.

Although the majority of the mitigation projects are part of an ongoing process that will take several years and their actual impacts will only be reported in the subsequent updates, the funding and commencement of these projects represents a commitment by the tribe to follow the plan and its recommendations. The tangible benefits of the completed and ongoing projects are expected to be shown after large hazard events that impact the mitigated areas, although these events did not occur in this period for the completed projects. For example, although located in the FEMA floodplain, no flood event occurred in this period large enough to flood the areas of the Sandy Point acquisition or the floodplain elevation projects. The effectiveness of the tribe's mitigation efforts, through the reduction of costs to life and property from natural hazards, will continue to improve through the monitoring of completed projects, the implementation of the recommended activities, and particularly the establishment of an Emergency Management Division.

6.6. Mitigation Funding Sources

In this section, current and potential sources of federal, tribal, state, local, or private funding for mitigation activities are identified. This plan, which was originally funded by a Pre-Disaster Mitigation (PDM) planning grant from FEMA and has been updated through a combination of tribal funding and grant funding obtained from the EPA, may help the Lummi Nation acquire funding from the following programs or agencies:

- **Pre-Disaster Mitigation Program**, which provides funds to develop mitigation plans and implement mitigation projects, is administered by FEMA. The Lummi Nation received a 2005 FEMA Pre-Disaster Mitigation-Competitive (PDM-C) grant for a total project cost of \$5,976,843 and a 75 percent federal share of \$4,482,632. The grant included two project subgrants and one management subgrant. The two projects were:
 - The Slater Road Elevation Project. This project was the elevation of an approximately 1-mile long, frequently flooded, section of Slater Road east of the

Nooksack River bridge to above the 100-year flood level. The elevation would include a 389 foot long bridge and allow continued access to the Reservation, Lummi Island, and nearby industries through a 100-year flood event. Due to higher than anticipated costs and a time delay, this grant was terminated for convenience, and the project will be funded by newly identified sources.

- The Sandy Point Coastal Acquisition Project. This project was the acquisition and removal of up to three homes from the high velocity coastal flood zone (V zone) along the Sandy Point Peninsula.
- **Hazard Mitigation Grant Program**, which provides post-disaster funds for hazard reduction projects (e.g., elevation, relocation, or buyout of structures), is administered by FEMA. The Lummi Nation may apply for funding directly to FEMA or to Washington State Emergency Management Division (by submitting this hazard mitigation plan to the state, the Lummi Nation will qualify as a sub-grantee).
- **Flood Control Assistance Account Program**, which provides funds for developing flood hazard management plans, for flood damage reduction projects and studies, and for emergency flood projects (e.g., repair of levees), is administered by the Washington State Department of Ecology (Ecology).
- **Flood Mitigation Assistance Program**, which provides funds for flood mitigation on buildings that carry flood insurance and have been damaged by floods, is administered by FEMA.
- **Repetitive Flood Claims Program**, which provides funds to reduce damages, primarily through acquisition and demolition or relocation, to insured properties that have had one or more claims to the National Flood Insurance Program (NFIP).
- **Severe Repetitive Loss Program**, which provides funds to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures under the NFIP. Severe repetitive loss structures are residential properties that:
 - Have at least four NFIP claim payments over \$5,000 each, when at least two such claims have occurred within any ten year period, and the cumulative amount of such claims payments exceeds \$20,000; or
 - For which at least two separate claims payments have been made with the cumulative amount of the building portion of such claims exceeding the value of the property, when two such claims have occurred within any ten year period.
- **Emergency Management Preparedness Assistance Grant Program (EMPAG)**, which provides funds to local and tribal governments, regional agencies, regional incident management teams, and private organizations to enhance statewide emergency preparedness through short term, high impact, projects. Administered by WEMD. The Lummi Nation received a 2006 EMPAG award for \$94,200 for the turnkey installation of two All-Hazard Alert Broadcast tsunami warning systems. This equipment was received in March 2007 and was installed by August 2007.
- **Department of Homeland Security**, which provides funding in addition to FEMA programs.
- **U.S. Fire Administration**, which provides wildfire program funds.

- **Environmental Protection Agency**, which could provide funds for projects with dual hazard mitigation and environmental protection goals as well as updates to this MHMP and related planning efforts such as spill prevention and response planning.
- **Indian Health Service**, which could provide funds for hazard mitigation projects that address public health and safety (e.g., water supply and wastewater collection and treatment systems).
- **USDA Rural Development**, which provides loan and grant funds for housing assistance, business assistance, community development, and emergency community water and wastewater assistance in areas covered by a federal disaster declaration.
- **Community Development Block Grant**, which provides funds for a variety of community development projects, is administered by the Department of Housing and Urban Development.
- **Small Business Administration Loans**, which help businesses recover from disaster damages, is administered by the Small Business Administration.
- **Bureau of Indian Affairs**, which provides funds to support tribal activities. The LNR Forestry Division receives funds from the BIA for forest protection services and used these funds in 2006 to purchase firefighter equipment and training.

Grant opportunities are also monitored by the Grants Office of the LIBC, and LNR is alerted if appropriate grants are made available by an agency.

In the past, Reservation residents and the Lummi Nation have received disaster relief funds directly from FEMA, or indirectly through the programs administered by Washington State. In addition, the Lummi Nation has secured grant funding from FEMA to develop a Flood Damage Reduction Plan, the 2004 Multi-Hazard Mitigation Plan, and to implement the Slater Road Elevation Project (not completed due to budget constraints) and the Sandy Point Coastal Acquisition Project.

Local potential funding sources for pre-disaster mitigation activities on the Reservation are very limited. Currently, the only potentially significant sources are the LIBC and the Silver Reef Hotel, Casino & Spa. However, the LIBC has a very limited tax base (essentially only permit fees and license fees as no property taxes are collected on trust properties and taxes on fee land are collected and retained by Whatcom County) and largely relies on funding from annual appropriations negotiated through the Bureau of Indian Affairs Office of Self-Governance and grant funds from other federal and state agencies. Profits from the Silver Reef Hotel, Casino & Spa are distributed through a prioritized system to various community programs. This distribution is based on initial casino profits being used to repay loans secured to build the casino and the remainder allocated pursuant to a formula approved by the LIBC. This allocation has been described as a “waterfall” where, depending on profit levels, available funding is provided to a specific program up to a specified amount. If available profits exceed the specified amount for the first priority program, funding is provided to the second priority program to its specified limit. If profits exceed this amount, the third prioritized program is funded to its limit. This allocation method is repeated until the profits are fully allocated. The most likely future use of such funds to support hazard mitigation is property acquisition, but hazard mitigation is currently

not specifically identified as a target for LIBC casino profits. As a result, financial support for hazard mitigation projects will largely rely on off-Reservation sources in the foreseeable future.

The ability of private citizens on the Reservation to pay for mitigation measures is also limited. While the per capita income of non-tribal residents generally exceeds that of surrounding Whatcom County, the \$17,000 median per capita income of tribal members (LIBC 2003) is significantly lower than the median income of Whatcom County residents. Hence, the ability of many tribal members to pay for hazard mitigation is very limited, and hazard mitigation may fall very low on the priority list for people struggling to pay for food, housing, energy, and other basic necessities.

There are other private companies and public agencies that could potentially help fund pre-disaster mitigation projects on or near the Reservation. Local public agencies and private companies that could fund such projects include Whatcom County, the City of Ferndale, and local businesses (most likely the two oil refineries and the aluminum smelter just north of the Reservation). All of these organizations would benefit from some of the mitigation projects proposed in this plan (e.g., raising Slater Road).

7. PLAN MAINTENANCE PROCESS

The federal hazard mitigation planning regulations (44 CFR 201.4) require state-level plans such as the original Lummi Nation MHMP to be reviewed, revised, and submitted for approval to the FEMA Regional Director every three years. The amendments to 44 CFR Part 201 at 72 Fed. Reg. 61720 published in October 2007 that guided the 2010 update and changed this plan from a state-level plan to a tribal plan call for updates every five years. These regulations require a plan maintenance process that includes an established method and schedule for monitoring, evaluating, and updating the plan; a system for monitoring implementation of mitigation measures and project closeouts; and a system for reviewing progress on achieving goals as well as specific activities and projects identified in the mitigation plan. This MHMP is a living document that is intended to provide a guide to hazard mitigation for the Lummi Nation. The MHMP can be revised more frequently than five years if the conditions under which it was developed change significantly (e.g., a major disaster occurs or funding availability changes). This section details the Lummi Nation's method and schedule for monitoring, evaluating, and updating the MHMP and for monitoring the progress of mitigation actions.

7.1. Responsibility for Plan Maintenance

The LIBC resolution adopting the 2004 version of the MHMP (Resolution No. 2004-015, Appendix A) directed the pertinent LIBC department directors to form a Multi-Hazard Mitigation Team (MHMT) by appointing appropriate representatives from their departments to be members of the MHMT. The core of the MHMT includes the Natural Resources Department Executive Director, the Planning and Public Works Department Director, the Chief of the Lummi Nation Police Department, the Director of the Cultural Resources Department (appointed in 2010 pursuant to LIBC Resolution No. 2010-093), the LIBC Safety Officer, and assigned staff from the Natural Resources, Planning and Public Works, and Cultural Resources departments. Other LIBC divisions (e.g., Accounting, Lummi Tribal Sewer and Water District, Lummi Commercial Company, Lummi Housing Authority) may be represented as needed. The MHMT is responsible for coordinating the implementation of mitigation measures and for overseeing the development, implementation, and monitoring of this plan and was authorized to continue this work under Resolution No. 2007-060, Resolution No. 2010-093, Resolution No. 2015-107 (Appendix A).

The MHMT met five times between 2004 and 2007 to discuss and review progress on mitigation projects, review the Lummi Nation Comprehensive Emergency Management Plan (CEMP) and Lummi Nation Spill Prevention and Response Plan, and discuss the MHMP update. Between 2007 and 2010, the Multi-Hazard Mitigation Team met four times to discuss and review mitigation projects and the MHMP update and over ten times to discuss the Slater Road Elevation Project. Between 2010 and 2015, the MHMT met one time to discuss current mitigation projects and identify proposed mitigation actions to pursue in the near-term future. Over this same time period, informal MHMT subcommittees met more than ten times to discuss the Coastal Flood Study (RiskMAP) Partnership Agreement, the Community Rating System Community Verification Visit, the 9-1-1 addressing project, the CEMP update, and the Whatcom County Floodplains by Design project, as well as participated in the LIBC Safety Committee

meetings. The Water Resources Division of the Lummi Natural Resources Department has served as the coordinator for the team and team meetings.

7.2. Monitoring, Evaluating, and Updating the Plan

7.2.1. 2004 Update Process

The 2004 MHMP called for an annual review of the MHMP and an update of the MHMP every three years. The annual reviews were to identify progress made on the implementation of mitigation measures and projects and to assess the impacts of disasters in the Reservation region to determine whether the MHMP should be revised based on the new information. Hazard mitigation progress and needs identified in the annual review were then to be described in an annual progress report for the LIBC and the General Council. The effectiveness of projects and other actions were to be evaluated at appropriate, project-specific intervals or, at a minimum, when the MHMP was updated every as three years required. The process of updating the MHMP was to include a review of hazard assessments, vulnerability assessments, potential losses, tribal capability, coordination with other planning efforts, funding sources, and recommended and potential new mitigation measures. In support of the update, the MHMT was to:

- Examine and revise the hazard risk assessment as necessary to ensure that it describes the current understanding of hazard risks.
- Examine progress and determine the effectiveness of the mitigation actions and projects recommended in the MHMP.
- Identify implementation problems (e.g., technical, political, legal, and financial) and develop recommendations to overcome these problems.
- Recommend ways to increase participation by LIBC departments and to improve coordination with other jurisdictions and agencies.
- Review and, if desirable, revise the MHMP priorities.

The updated MHMP was then to be presented to the LIBC commissions identified in Section 2 (Planning Process) for approval and then to the LIBC for adoption before it's submittal to FEMA for approval.

7.2.2. 2007 Update Process

Between 2004 and 2007, practical application of the plan update process outlined above led to an experience-based adaptation of the process. The Multi-Hazard Mitigation Team met five times from 2004 to 2007 primarily to discuss direction for and progress on mitigation projects and to evaluate the plan for the three year update. The impacts of disasters and any subsequent changes to the previous vulnerability assessments were reviewed for the three-year update, but not as part of annual reviews and annual progress reports. The MHMT determined that, with good record keeping of hazard events, the three year review was sufficient for incorporation of recent hazard events and reevaluation of the vulnerability assessment. Project progress was reported to the General Council through articles in the community newspaper (Squol Quol) and Lummi Nation News television broadcasts and to the LIBC through the Natural Resources and Planning and Public Works department's annual reports. Based on the MHMT's three year review of this

process, it was recommended that a more regular schedule be established and followed for MHMT meetings, the original annual review recommendation be removed, and the annual progress report be considered submitted through the ongoing newspaper articles and required departmental annual reports.

The first three year plan update was performed in 2007, adopted by the LIBC by Resolution No. 2007-060 (Appendix A), and submitted to FEMA on April 24, 2007. In summary, the update was completed pursuant to FEMA regulations and guidance and the process outlined in this section. The update included the review of hazard event information and new scientific information and gathering input from the MHMT and the relevant LIBC commissions. The original document was modified by updating the description of the Reservation, the natural hazard risk assessment, and the mitigation strategy. The assessment of each hazard was updated as appropriate to include new information, new hazard occurrences, input on vulnerabilities from the MHMT and commissions, and current valuation data for loss estimates. All of the vulnerability maps were revised to include then current GIS base layers (e.g., parcels, structures, roads, water bodies, land surface elevation) and the vulnerability areas for earthquakes, coastal erosion, wildfires, landslides, and tsunamis were changed to incorporate new information. The mitigation strategy was revised by incorporating mitigation activities begun and completed since 2004, editing the recommended mitigation measures and priorities, adding new funding sources, and revising the mitigation action plan to reflect progress and changes. A list of changes is available in Table 2.1 – Summary of the Lummi Nation MHMP Changes (2004-2007).

7.2.3. 2010 Update Process

The Multi-Hazard Mitigation Team met four times between plan updates in 2007 and 2010 to discuss and review mitigation projects and the MHMP update. In addition, the MHMT met approximately ten times over this same time period to discuss the Slater Road Elevation Project. In preparation for the 2010 MHMP update, the Lummi Water Resources Division staff members responsible for the plan update participated in FEMA focus groups and trainings that reviewed the newly developed guidelines for tribal-level multi-hazard mitigation plans. Pursuant to the new federal guidelines, the only significant change to the plan update process was the addition of public outreach activities. In 2010, the MHMT conducted a letter writing campaign to businesses and other institutions located on the Reservation to help introduce the public to the MHMP and solicit input for the update that was underway. This campaign was supported by an announcement in the Squol Quol. The 2010 update to the MHMP followed the process described above, was adopted by the LIBC by Resolution No. 2010-093 (Appendix A) on May 25, 2010, and was submitted to FEMA on July 20, 2010. Details concerning changes and updates from the previous plan are listed in Table 2.2 – Summary of the Lummi Nation MHMP Changes (2007-2010).

7.2.4. 2015 Update Process

Between 2010 and 2015, the Multi-Hazard Mitigation Team met one time to discuss current mitigation projects and identify proposed mitigation actions to pursue in the near-term future. Over this same time period, informal MHMT subcommittees met more than ten times to discuss the Coastal Flood Study (RiskMAP) Partnership Agreement, the Community Rating System Community Verification Visit, the 9-1-1 addressing project, the Comprehensive Emergency Management Plan (CEMP) update, and the Whatcom County Floodplains by Design project, as

well as participated in the LIBC Safety Committee meetings. Two noteworthy changes to the plan update process occurred between 2010 and 2015. First, was the appointment of the Cultural Resources Department Director as a new member of the MHMT pursuant to LIBC Resolution No. 2010-093. Second, was the determination that the 2015 update needed to be reviewed by the MHMT, but not the relevant LIBC commissions as had been done previously. This action was deemed appropriate during the 2015 update because there were no substantive changes made to the goals and objectives, hazard vulnerability rankings, or mitigation priorities of the MHMP and there were no new federal requirements for tribal multi-hazard mitigation plans issued by FEMA over the 2010 to 2015 period. Otherwise, the plan update process proceeded as outlined above. The 2015 update to the MHMP was adopted by the LIBC by Resolution No. 2015-107 (Appendix A) on September 1, 2015 and submitted to FEMA on September 16, 2015. Details concerning changes and updates from the previous plan are listed in Table 2.3 – Summary of the Lummi Nation MHMP Changes (2010-2015).

7.2.5. Planned Update Process 2015 through 2020

Pursuant to amendments to 44 CFR Part 201, the current and future MHMP updates will be submitted to FEMA every five years. Because increased public participation will make the plan and its implementation more effective, the MHMT will continue to use informational mailings, regular Squol Quol articles, website postings, announcements at General Council meetings, and other means to encourage public participation. The regular monitoring and update processes described above will also be continued. Until the creation of the Emergency Manager Position in the Lummi Nation Police Department, the Water Resources Division of the Lummi Natural Resources Department will continue to collect information about hazards and new hazard events that affect the Reservation and will continue to coordinate the MHMT meetings. Upon creation of the Emergency Management Division and Emergency Manager position, these duties together with future updates of the Lummi Nation MHMP may be transferred to the Lummi Nation Police Department. The MHMT will continue to oversee the update of this living document.

7.3. Monitoring Progress of Mitigation Actions

7.3.1. 2004 Monitoring Process

The planned process of monitoring mitigation actions was outlined in the 2004 MHMP. In summary, the MHMT was to meet on a regular basis to ensure consistent progress on the implementation of mitigation actions. Representatives to the MHMT were to report on the progress made by their respective departments. Departments not represented on the MHMT were to be invited to meetings as needed to report on activities in their departments. The implementation of all short-term mitigation actions was to be monitored by the MHMT on an ongoing basis until implementation was complete. Long-term actions being actively implemented were to be monitored on an ongoing basis, or at least annually as needed. Long-term actions planned for the future were to be reviewed during plan updates every three years.

The system for reviewing progress on achieving goals, objectives, and specific actions included in the mitigation strategy was to be based on a checklist of all objectives and actions. This checklist was to be reviewed annually by the MHMT. As described previously, progress on mitigation actions was to be described in an annual report to the LIBC and the General Council and in the three year update of the MHMP.

In addition to the work products described in approved work plans for projects funded by the Pre-Disaster Mitigation Program, the Hazard Mitigation Grant Program, the Flood Mitigation Assistance Program, or other grant programs, quarterly or semi-annual (depending on reporting requirements of funding agencies) performance reports that identify accomplishments toward completing the work plan commitments, a discussion of the work performed for all work plan components, a discussion of any existing or potential problem areas that could affect project completion, budget status, and planned activities for the subsequent quarter were to be submitted to the funding agency by the assigned LIBC Project Officer. The agency-specific final grant closeout documents were also to be prepared by the LIBC Project Officer at the conclusion of the performance period and submitted to the funding agency.

7.3.2. 2007 Monitoring Process

Between 2004 and 2007, the MHMT met as needed to gather the team's input on project direction and progress and to gather mitigation activity information from each department. Monthly meetings were not necessary and the MHMT recommended that future meetings be held on a quarterly or semi-annual schedule. At the MHMT meetings, the system used for evaluating projects and tracking project progress was a table (now Table 6.11) listing the mitigation actions detailed in Section 6.2 – Mitigation Measures.

The Lummi Water Resources Division (LWRD) served as the team coordinator and was the lead for applying for mitigation project grants, managing these grants, and providing information to the MHMT and General Council on project progress. For the three Pre-Disaster Mitigation-Competitive (PDM-C) project grants, the LWRD submitted the required quarterly financial and performance reports to FEMA through the e-Grants system. These reports described activities that demonstrated quarterly performance as compared to the objectives established in the grant applications, described any anticipation of time or budget overruns, and provided budget reports. The LWRD also submitted monthly progress and financial reports to the WEMD for the EMPAG grant for the tsunami warning systems. These reports included project activities for each month, deliverables achieved as detailed in the work plan, improvements to the identified baseline, and a discussion of successes and challenges encountered.

In summary, the process that has been used to implement the plan and monitor progress has been that the MHMT has chosen and guided projects based on the plan and Table 6.11, projects have been implemented by the LIBC departments, and the team has received reports on project progress. This monitoring process has shown that a number of mitigation activities have been started or completed since the adoption of the original plan in 2004 and clarifies actions that should follow. The Lummi Water Resources Division will continue to coordinate the team, track project progress, and apply for and manage project grants. This responsibility may be turned over to the Lummi Nation Police Department when the Emergency Management Division is established. The recommended changes to the originally described monitoring process are for the MHMT to meet semi-quarterly or as required, for Table 6.11 to continue to be used as a tracking system, and for the coordination responsibility to be transferred to an Emergency Manager when appropriate.

7.3.3. 2010 Monitoring Process

Between 2007 and 2010, the monitoring process described above in Section 7.3.2 was continued. The MHMT met four times to discuss establishing the position of Emergency Manager, the maintenance of the AHAB towers and the coordination of the warning system with Washington State, the 2009 flooding disaster, the installation of the tsunami evacuation route signs, the 9-1-1 address signs, grant opportunities, and the Sandy Point Coastal Acquisition Project. The MHMT met approximately ten times in regards to the Slater Road Elevation Project. Quarterly meetings were determined not to be feasible during this three year interval due to the time constraints of MHMT members and, as a result, MHMT meetings were scheduled as needed. The Lummi Water Resources Division continued to manage the grants and submit quarterly and annual finance and performance reports to the appropriate agencies. The LWRD was also the lead in securing alternative financing for the Slater Road Elevation Project (Mitigation Action FA4). The prioritized list of mitigation actions summarized in Table 6.11 continued to guide the strategy of the MHMT.

7.3.4. 2015 Monitoring Process

Between 2010 and 2015, the monitoring process described above and the use of the prioritized list of mitigation actions summarized in Table 6.11 continued to guide the strategy of the MHMT. The Multi-Hazard Mitigation Team met one time to discuss current mitigation projects and identify proposed mitigation actions to pursue in the near-term future and informal MHMT subcommittees met over ten times to discuss specific projects. Quarterly meetings were again determined not to be feasible; meetings were scheduled on an as needed basis. The LWRD continued to lead the plan monitoring and update process.

7.3.5. 2015 through 2020 Monitoring Process

The list of mitigation actions summarized in Table 6.11 will continue to be the instrument guiding the prioritization and commencement of new hazard mitigation projects. The Lummi Water Resources Division will continue to coordinate the MHMT, track project progress, apply for and manage project grants, and coordinate public outreach and education efforts. These responsibilities may be transferred to the Emergency Manager of the Emergency Management Division when this position is established within the Lummi Nation Police Department. The MHMT will continue to meet as needed, but will aim for the entire team to meet at least once annually. Progress toward implementing the Multi-Hazard Mitigation Plan will be monitored and evaluated during these meetings and any corrective actions will be identified. Project-specific meetings will also occur as needed, which is expected to be more frequently than the general MHMT meetings. The MHMT will request support from the appropriate LIBC commissions to advance certain mitigation actions (e.g., Cultural Resources Protection and Mitigation Plan, Post Disaster Management Plan).

7.4. Integration with Existing Plans

The MHMP works in concert with other plans, regulations, and management programs. One such measure is the Land Use, Zoning, and Development Code (LCL Title 15). Title 15 reduces hazards by ensuring that all proposed development on the Reservation is first evaluated for potential environmental impacts before being authorized. The Lummi Nation Flood Damage

Prevention Code (LCL Title 15A) further addresses flood hazards on the Reservation, as does the Lummi Nation Flood Damage Reduction Plan (LWRD 2001a). The Lummi Nation Coastal Zone Management Plan and the Tidelands Code (LCL Title 13) control activities in the coastal zone of the Reservation. The Lummi Nation Building Code (LCL Title 22) ensures that structures are constructed in a manner such that they will be safer for people during a disaster. The Solid Waste Control and Disposal Code (LCL Title 18) will reduce environmental damage caused by flood events. These codes are administered by the Lummi Planning and Public Works Department. To guide future land uses on the Reservation, Planning and Public Works Department is also developing a Comprehensive Land Use Plan for the Reservation. In addition, the Lummi Natural Resources Department (LNR) administers the Water Resources Protection Code (LCL Title 17) as part of its Comprehensive Water Resources Management Program (CWRMP). The CWRMP includes wellhead protection, storm water management, wetland management, nonpoint source pollution management, and water quality standards programs. All mitigation measures must also comply with the Cultural Resources Preservation Code (LCL Title 40) which guides cultural resource management on the Reservation and is administered by the Cultural Resources Department. The Natural Resources Department was also responsible for the development of the Assessment of Climate Change Impacts on the Lummi Indian Nation and the mitigation and adaption measures recommended therein. The Lummi Nation Police Department administers activities related to the Lummi Nation Comprehensive Emergency Management Plan. This MHMP supports and complements these current on-Reservation programs and activities and also promotes continued involvement in appropriate off-Reservation activities related to hazard mitigation.

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8. CONCLUSION

The Lummi Nation Multi-Hazard Mitigation Plan (MHMP) is an important tool for the Lummi Nation's effort to become a disaster-resistant community. This MHMP assesses the vulnerability of six geographic areas of the Lummi Indian Reservation (i.e., Lummi Peninsula, Gooseberry Point, Floodplain, Northwest Upland, Sandy Point Peninsula, and Portage Island) to eleven natural hazards. These hazards are:

- Floods
- Earthquakes
- Severe Winter Storms
- Windstorms
- Coastal Erosion
- Drought
- Wildfires
- Landslides
- Tsunamis
- Volcano Eruptions
- Tornadoes

The vulnerability of the Reservation to these hazards depends on several factors including the severity of the event, the probability and frequency of occurrence, the size of the area impacted, geographic features such as steep slopes or soil types that may exacerbate a given hazard, the density of development or other land use issues in certain areas that may increase the impact of a given hazard, affected vulnerable populations or cultural properties, and affected places of business and employment, emergency services, or utilities. The vulnerability and potential losses caused by each hazard were estimated by evaluating these factors for each of the six geographic assessment areas. This evaluation determined that:

- Riverine and coastal floods are frequent and severe threats to the Reservation, causing damage to structures due to inundation (and wave action in the case of coastal floods) mainly in the Floodplain, Gooseberry Point, and the Sandy Point Peninsula assessment areas. Severe riverine floods can prevent access to the Lummi Peninsula and Gooseberry Point, which delays emergency response and results in economic losses.
- Strong earthquakes are infrequent on the Reservation, but a large-magnitude Cascadia Subduction Zone earthquake has the potential to cause severe damage, especially in areas with soils subject to liquefaction. The Floodplain assessment area contains the largest extent of these soil types. Additionally, a Cascadia Subduction Zone earthquake could generate a tsunami that would inundate the Sandy Point Peninsula and the Floodplain assessment areas and cause severe damage to residences and other structures along the coastline.

- Severe winter storms and windstorms occur frequently on or near the Reservation. High winds can cause trees to fall onto buildings and homes and down power lines. The forested areas of the Reservation, including the Northwest Upland, Lummi Peninsula, and Portage Island, are most impacted by high winds. Winter storms pose additional risks to transportation due to snow and ice on roads, particularly along exposed roadways in the Floodplain area.
- The Reservation is bordered by approximately 38 miles of marine shoreline. Erosion rates along all of the Reservation shorelines have been evaluated and several coastal reaches have been measured to have high erosion rates. Coastal erosion endangers properties along the shoreline and cultural, natural, and economic resources.
- Drought is a hazard that occurs across the Pacific Northwest, typically during years that are preceded by less than average snowpack in the winter season in combination with warm and dry summers. Drought affects all six geographic areas of the Reservation.
- Wildfires can and do occur in the forested and grassland areas of the Reservation, typically during the warm and dry summer season. However, vulnerability to this hazard was ranked relatively low, largely because the fires that have occurred since the 19th century have been effectively and quickly contained.
- Landslides threaten several steep slopes on the Reservation, several of which are on the marine shoreline and are also impacted by coastal erosion. Additionally, steep slopes occur inland along the Northwest Upland and on the Lummi Peninsula.
- Tsunamis have been recorded in the Reservation region in the past and have the potential to inundate the low-lying areas of the Floodplain, Gooseberry Point, and Sandy Point Peninsula assessment areas. Tsunamis in the Reservation region are infrequent, but pose the threat of severe damage and loss of life.
- Mount Baker is an active volcano in the vicinity of the Reservation. The primary danger from an eruption is a resulting lahar channeled downstream along the North Fork of the Nooksack River. Current models assume that the lahar would not reach the Reservation, however it would have the same effect as a severe riverine flood by “pushing” the water of the river along its front.
- Tornadoes occur in Washington State regularly at a rate of approximately two per year. One tornado occurred in Whatcom County since 2004. A tornado would cause the most damage in the densely developed areas on the Reservation but no prior occurrence is recorded.

The hazards described above are addressed by a mitigation strategy formulated by the Multi-Hazard Mitigation Team (MHMT) and approved by the Lummi Indian Business Council (LIBC). The MHMT consists of the Natural Resources Department Executive Director, the Planning and Public Works Department Director, the Chief of the Lummi Nation Police, the Cultural Resources Department Director (position appointed in 2010 pursuant to LIBC Resolution No. 2010-093), the LIBC Safety Officer, and assigned staff from the Natural Resources, Planning and Public Works, and Cultural Resources departments. Hazard mitigation actions include regulations in the Lummi Nation Code of Laws (LCL) that require, for instance, structural adaptations for earthquake and flood safety, and include a rigorous permitting process that regulates the location and nature of development that can occur on the Reservation.

These regulations and policies include:

- Natural Resources Code (LCL Title 10)
- Tidelands Code (LCL Title 13)
- Land Use, Zoning, and Development Code (LCL Title 15)
- Flood Damage Prevention Code (LCL Title 15A)
- Water Resources Protection Code (LCL Title 17)
- Solid Waste Control and Disposal Code (LCL Title 18)
- Building Code (LCL Title 22)
- Cultural Resources Protection Code (LCL Title 40)
- Coastal Zone Management Plan
- Comprehensive Emergency Management Plan
- Comprehensive Water Resources Management Program

The Lummi Nation also participates in the National Flood Insurance Program (NFIP), the Community Rating System (CRS), and Community Assistance Visits (CAVs), which are administered by the Federal Emergency Management Agency (FEMA) and address flood hazards on the Reservation. Man-made hazards are addressed through implementation the Lummi Nation Oil Spill Prevention and Response Plan by the Lummi Spill Response Team.

The MHMT proposes and executes mitigation actions consistent with the MHMP that address threats from hazards on the Reservation. For instance, these mitigation actions include the installation of All-Hazard Alert Broadcast (AHAB) warning systems in locations potentially affected by tsunamis, the elevation of roads to prevent the isolation of the Lummi Peninsula during floods (e.g., Marine Drive Elevation Project), and the acquisition and removal of flood-prone structures along the coastline (e.g., Sandy Point Coastal Acquisition Project). The mitigation actions further emphasize public outreach and education about hazard mitigation and preparedness. Additionally, coordination with federal, tribal, state, and local hazard mitigation and emergency management agencies is an important component of the mitigation strategy. By developing a comprehensive mitigation strategy as part of this MHMP, the Lummi Nation is eligible for grants to execute proposed mitigation actions and continuing planning efforts. Potential funding sources include federal agencies, state agencies, and local agencies.

The Lummi Nation MHMP was prepared by the Water Resources Division (LWRD) of the Lummi Natural Resources Department (LNR) and complies with 44 Code of Federal Regulations (CFR) Part 201 and its amendments. The MHMP was first adopted by the LIBC through Resolution No. 2004-015 in January 2004 and approved by FEMA in May 2004. The MHMP was comprehensively updated in 2007 (adopted by LIBC Resolution No. 2007-060), 2010 (adopted by LIBC Resolution No. 2010-093), and 2015 (LIBC Resolution No. 2015-107). As part of the 2010 update, the MHMP changed status from a state-level plan to a tribal plan.

The MHMT will continue to monitor hazard events on the Lummi Indian Reservation, pursue mitigation actions, and revise the mitigation strategy described in the Lummi Nation MHMP as new information becomes available.

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10. LIST OF ACRONYMS AND ABBREVIATIONS

Programs and Terms:	
AHAB	All-Hazard Alert Broadcast
BFE	Base Flood Elevation
CAV	Community Assistance Visit
CEMP	Comprehensive Emergency Management Plan
CFHMP	Comprehensive Flood Hazard Management Plan
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CRS	Community Rating System
CWRMP	Comprehensive Water Resources Management Program
CZMP	Coastal Zone Management Plan
EAs	Environmental Assessments
EISs	Environmental Impact Statements
EMPAG	Emergency Management Preparedness Assistance Grant
EOC	Emergency Operations Center
FDPC	Flood Damage Prevention Code
FDRP	Flood Damage Reduction Plan
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FTE	Full-Time Equivalent
GIS	Geographic Information System
HAZUS	Hazards – United States (FEMA software program)
LIDAR	Light Detection and Ranging
LCL	Lummi Code of Laws
MHMP	Multi-Hazard Mitigation Plan
MHMT	Multi-Hazard Mitigation Team
MMI	Modified Mercalli Intensity
NAVD88	North American Vertical Datum of 1988
NEHRP	National Earthquake Hazard Reduction Program
NEPA	National Environmental Policy Act
NERP	Nooksack Estuary Recovery Project
NFIP	National Flood Insurance Program
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
SEPA	State Environmental Policy Act
SFHA	Special Flood Hazard Area
SRL	Severe Repetitive Loss

SWMP	Storm Water Management Program
Squol Quol	Lummi Nation Newspaper
TEPA	Tribal Environmental Policy Act
TRC	Technical Review Committee
UBC	Uniform Building Code

Agencies and Organizations (Parent Organization):	
AMS	American Meteorological Society
BIA	U.S. Bureau of Indian Affairs
CISN	California Integrated Seismic Network
Corps	U.S. Army Corps of Engineers
DNR	Washington State Department of Natural Resources
DOH	Washington State Department of Health
Ecology	Washington State Department of Ecology
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
GSC	Geological Survey of Canada
LCC	Lummi Commercial Company
LIBC	Lummi Indian Business Council
LNR	Lummi Natural Resources Department
LWRD	Lummi Water Resources Division
LTSWD	Lummi Tribal Sewer and Water Districts
NEI	Northwest Economics, Inc.
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service (USDA)
NWIC	Northwest Indian College
NWS	National Weather Service
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USEPA/EPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service (USDI)
USGS	U.S. Geological Survey (USDI)
WCATWC	West Coast and Alaska Tsunami Warning Center
WEMD	Washington State Emergency Management Division
WSDC	Washington State Department of Conservation

APPENDIX A

LIBC Resolution No. 2004-015

“Adoption of the Lummi Nation Multi-Hazard Mitigation Plan”

LIBC Resolution No. 2007-060

“Adoption of the 2007 Lummi Nation Multi-Hazard Mitigation Plan”

LIBC Resolution No. 2010-093

“Adoption of the 2010 Lummi Nation Multi-Hazard Mitigation Plan”

LIBC Resolution No. 2015-107

“Adoption of the 2015 Lummi Nation Multi-Hazard Mitigation Plan”

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LUMMI INDIAN BUSINESS COUNCIL

2616 KWINA ROAD • BELLINGHAM, WASHINGTON 98226 • (360) 384-1489

Natural Res.

RESOLUTION # 2004 - 015 OF THE LUMMI INDIAN BUSINESS COUNCIL

TITLE: Adoption of the Lummi Nation Multi-Hazard Mitigation Plan

WHEREAS, the Lummi Indian Business Council is the duly constituted governing body of the Lummi Indian Reservation by the authority of the Constitution and By-laws of the Lummi Nation of the Lummi Reservation, Washington; and

WHEREAS, the Council is responsible for protecting and ensuring the health, safety, and welfare of the Lummi People and the Lummi Reservation community; and

WHEREAS, the Council is responsible for the protection, restoration, enhancement, and management of the natural resources within the exterior boundaries of the Lummi Reservation and throughout the Lummi Nation's Usual and Accustomed (U&A) Fishing and Gathering Grounds and Stations; and

WHEREAS, natural hazard events have occurred in the past and larger events can be expected to occur in the future on and near the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, defined hazard management policies and a coordinated hazard plan will reduce the impacts of natural hazard events on the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan identifies proposed actions for hazard preparedness and damage reduction, recommends priorities for natural hazard mitigation, and gains eligibility for future hazard mitigation programs; and

WHEREAS, implementation of the Lummi Nation Multi-Hazard Mitigation Plan will reduce natural hazard-related damages, reduce environmental impacts of hazard mitigation activities, and reduce the long-term costs of hazard mitigation; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan is consistent with the Lummi Flood Damage Prevention Code (Title 15A Lummi Nation Code of Laws), the Lummi Zoning Code (Title 15 Lummi Nation Code of Laws), the Lummi Building Code (Title 22 Lummi Nation Code of Laws), and the Water Resources Protection Code (Title 17 Lummi Nation Code of Laws); and

WHEREAS, the Lummi Fisheries and Natural Resources Commission (at their meeting on November 25, 2003), the Lummi Natural Resources Department Executive Director, the Lummi Planning Commission (at their meeting on December 18, 2003), and the Lummi Law and Justice Commission (at their meeting on January 15, 2004) recommend that the Lummi Indian Business Council adopt the Lummi Nation Multi-Hazard Mitigation Plan.

NOW THEREFORE BE IT RESOLVED, that the Lummi Indian Business Council adopts the Lummi Nation Multi-Hazard Mitigation Plan and directs the Directors of the Natural Resources and the Planning departments to designate appropriate staff members to implement the actions identified in the plan; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council authorizes the formation of a Multi-Hazard Mitigation Team and directs the General Manager or his designee to coordinate the formation, staffing, and operations of this team and to ensure its effectiveness; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council directs the Multi-Hazard Mitigation Team to report its activities semi-annually to the General Manager or his designee and annually to the Lummi Indian Business Council and General Council; and

BE IT FURTHER RESOLVED, that the Chairman (or Vice Chairman in his absence is hereby authorized and directed to execute this resolution and any documents connected therewith, and the Secretary (or the Recording Secretary in his absence) is authorized and directed to execute the following certification.

LUMMI INDIAN NATION

Darrell Hillaire
Darrell Hillaire, Chairman
Lummi Indian Business Council

CERTIFICATION

As Secretary of the Lummi Indian Business Council, I hereby certify that the above Resolution #2004-015 was adopted at a Regular Meeting of the Council held on the 19th of January 19, 2004, at which time a quorum of 7 was present by a vote of 6 For, 0 Against, and 0 Abstentions(s).



Sheri Williams
Sheri Williams, Secretary
Lummi Indian Business Council

Resolution 2004-015

Corrected version per 1/19/04 approved minutes



LUMMI INDIAN BUSINESS COUNCIL

2616 KWINA ROAD • BELLINGHAM, WASHINGTON 98226 • (360) 384-1489

RESOLUTION # 2007 - 060 OF THE LUMMI INDIAN BUSINESS COUNCIL

TITLE: Adoption of the 2007 Lummi Nation Multi-Hazard Mitigation Plan

WHEREAS, the Lummi Indian Business Council is the duly constituted governing body of the Lummi Indian Reservation by the authority of the Constitution and By-laws of the Lummi Nation of the Lummi Reservation, Washington; and

WHEREAS, the Council is responsible for protecting and ensuring the health, safety, and welfare of the Lummi People and the Lummi Reservation community; and

WHEREAS, the Council is responsible for the protection, restoration, enhancement, and management of the natural resources within the exterior boundaries of the Lummi Reservation and throughout the Lummi Nation's Usual and Accustomed (U&A) Fishing and Gathering Grounds and Stations; and

WHEREAS, natural hazard events have occurred in the past and larger events can be expected to occur in the future on and near the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, defined hazard management policies and a coordinated hazard management plan, with a focus on the homeland, will reduce the impacts of natural hazard events on the Lummi Reservation and within the Lummi Nation's U&A ; and

WHEREAS, the Council adopted the Lummi Nation Multi-Hazard Mitigation Plan by resolution 2004-015 on January 19, 2004 as recommended by the Lummi Fisheries and Natural Resources Commission, the Lummi Nation Natural Resources Department Director, the Lummi Planning Commission, and the Lummi Law and Justice Commission; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan identifies proposed actions for hazard preparedness and damage reduction, recommends priorities for natural hazard mitigation, and gains eligibility for future hazard mitigation programs; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan was developed in compliance with the Stafford Act and FEMA regulations and allows the Lummi Nation to be eligible for certain hazard mitigation and disaster response funding sources; and

WHEREAS, to remain eligible for these funding sources, FEMA requires the Plan to be updated every three years to reflect changes in development, progress in mitigation efforts, and changes in priorities and to be resubmitted to the FEMA Regional Director; and

WHEREAS, members of the Lummi Multi-Hazard Mitigation Team met on January 25, 2007, to review and discuss potential changes to the 2004 plan, provided input on the update, and recommended that the updated plan be presented to the affected Lummi commissions; and

WHEREAS, members of the Lummi Natural Resources Commission, the Lummi Planning Commission, and the Lummi Cultural Commission met on February 28, 2007, were presented with a summary of changes to the 2004 plan, provided input on the update, and recommended that the Council adopt the updated plan; and

WHEREAS, continued implementation of the Lummi Nation Multi-Hazard Mitigation Plan will reduce natural hazard-related damages, reduce environmental impacts of hazard mitigation activities, and reduce the long-term costs of hazard mitigation; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan is consistent with the Lummi Flood Damage Prevention Code (Title 15A Lummi Nation Code of Laws), the Lummi Zoning Code (Title 15 Lummi Nation Code of Laws), the Lummi Building Code (Title 22 Lummi Nation Code of Laws), and the Water Resources Protection Code (Title 17 Lummi Nation Code of Laws).


NOW THEREFORE BE IT RESOLVED, that the Lummi Indian Business Council adopts the 2007 Lummi Nation Multi-Hazard Mitigation Plan and directs the Directors of the Natural Resources and the Planning departments to continue to designate appropriate staff members to implement the actions identified in the plan; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council authorizes the Multi-Hazard Mitigation Team to continue its work and directs the General Manager or his designee to coordinate the ongoing staffing and operations of this team and to ensure its effectiveness; and

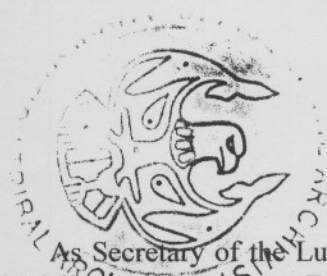
BE IT FURTHER RESOLVED, that the Lummi Indian Business Council directs the Multi-Hazard Mitigation Team to report its activities annually to the Lummi Indian Business Council and General Council and to update the plan every three years; and

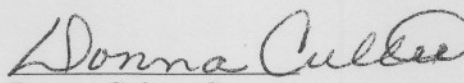
BE IT FURTHER RESOLVED, that the Chairwoman (or Vice Chairman in her absence is hereby authorized and directed to execute this resolution and any documents connected therewith, and the Secretary (or the Recording Secretary in her absence) is authorized and directed to execute the following certification.

LUMMI NATION


Evelyn Jefferson, Chairwoman
Lummi Indian Business Council

CERTIFICATION


As Secretary of the Lummi Indian Business Council, I hereby certify that the above Resolution #2007-060 was adopted at a Regular Meeting of the Council held on the 17th of April 2007, at which time a quorum of 6 was present by a vote of 5 For, 0 Against, and 0 Abstentions(s).


Donna Cultee, Secretary
Lummi Indian Business Council



LUMMI INDIAN BUSINESS COUNCIL

2616 KWINA ROAD • BELLINGHAM, WASHINGTON 98226 • (360) 384-1489

RESOLUTION # 2010 - 093 OF THE LUMMI INDIAN BUSINESS COUNCIL

TITLE: Adoption of the 2010 Lummi Nation Multi-Hazard Mitigation Plan

WHEREAS, the Lummi Indian Business Council (LIBC) is the duly constituted governing body of the Lummi Indian Reservation by the authority of the Constitution and By-laws of the Lummi Nation of the Lummi Reservation, Washington; and

WHEREAS, pursuant to Article VI(I) of the Lummi Constitution, the LIBC is required to safeguard and promote peace, safety, and welfare of the Lummi People and the Lummi Reservation community; and

WHEREAS, the LIBC is responsible for the protection, restoration, enhancement, and management of the natural resources within the exterior boundaries of the Lummi Reservation and throughout the Lummi Nation's Usual and Accustomed (U&A) Fishing and Gathering Grounds and Stations; and

WHEREAS, natural hazard events have occurred in the past and larger events can be expected to occur in the future on and near the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, defined hazard management policies and a coordinated hazard management plan, with a focus on the homeland, will reduce the impacts of natural hazard events on the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, the LIBC adopted the Lummi Nation Multi-Hazard Mitigation Plan by resolution 2004-015 on January 19, 2004 as recommended by the Lummi Fisheries and Natural Resources Commission, the Lummi Nation Natural Resources Department Director, the Lummi Planning Commission, and the Lummi Law and Justice Commission, and directed that a Multi-Hazard Mitigation Team be established; and

WHEREAS, the LIBC adopted the 2007 update of the Lummi Nation Multi-Hazard Mitigation Plan by resolution 2007-060 on April 16, 2007 as recommended by the Lummi Multi-Hazard Mitigation Team, the Lummi Fisheries and Natural Resources Commission, the Lummi Nation Natural Resources Department Director, the Lummi Planning Commission, and the Lummi Law and Justice Commission; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan identifies proposed actions for hazard preparedness and damage reduction, and recommends priorities for natural hazard mitigation; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan was developed in compliance with the Stafford Act and FEMA regulations and allows the Lummi Nation to be eligible for certain hazard mitigation and disaster response funding sources; and

WHEREAS, to remain eligible for these funding sources, FEMA has required the Plan to be updated every three years to reflect changes in development, progress in mitigation efforts, and changes in priorities and to be resubmitted to the FEMA Regional Director; and

WHEREAS, members of the Lummi Multi-Hazard Mitigation Team met on May 4, 2010 to review and discuss potential changes to the 2007 plan, provide input on the update, and recommended that the updated plan be presented to the affected Lummi commissions; and

WHEREAS, members of the Lummi Planning Commission, the Lummi Law and Justice Commission, the Lummi Natural Resources Commission, and the Lummi Cultural Commission were presented with a summary of changes to the 2007 plan, provided input on the update, and recommended that the Council adopt the updated plan on May 5, 2010, May 11, 2010, May 14, 2010, and May 18, 2010 respectively; and

WHEREAS, continued implementation of the Lummi Nation Multi-Hazard Mitigation Plan will reduce natural hazard-related damages, reduce environmental impacts of hazard mitigation activities, and reduce the long-term costs of hazard mitigation; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan is consistent with the Lummi Flood Damage Prevention Code (Title 15A Lummi Nation Code of Laws), the Lummi Zoning Code (Title 15 Lummi Nation Code of Laws), the Lummi Building Code (Title 22 Lummi Nation Code of Laws), and the Water Resources Protection Code (Title 17 Lummi Nation Code of Laws).

NOW THEREFORE BE IT RESOLVED, that the Lummi Indian Business Council adopts the 2010 Lummi Nation Multi-Hazard Mitigation Plan; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council directs the General Manager to appoint the Schelangen Director or his designee as a member in the Multi-Hazard Mitigation Team and directs the Schelangen Director to designate appropriate staff to implement the actions identified in the plan; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council authorizes the Multi-Hazard Mitigation Team to continue its work and directs the General Manager or his designee to coordinate the ongoing staffing and operations of this team and to ensure its effectiveness; and

BE IT FURTHER RESOLVED, that the Lummi Indian Business Council directs the Multi-Hazard Mitigation Team to update the plan every five years consistent with the updated FEMA guidance; and

BE IT FURTHER RESOLVED, that the Chairman (or Vice Chairman in his absence) is hereby authorized and directed to execute this resolution and any documents connected therewith, and the Secretary (or the Recording Secretary in his absence) is authorized and directed to execute the following certification.

LUMMI NATION


Henry Cagay, Chairman
Lummi Indian Business Council

CERTIFICATION

As Secretary of the Lummi Indian Business Council, I hereby certify that the above Resolution #2010-093 was adopted at a Regular Meeting of the Council held on the 25th of May 2010, at which time a quorum of 9 was present by a vote of 0 For, 0 Against, and 0 Abstentions(s).


Jim Wilson, Secretary
Lummi Indian Business Council



LUMMI INDIAN BUSINESS COUNCIL

2665 KWINA ROAD • BELLINGHAM, WASHINGTON 98226 • (360) 312-2000

RESOLUTION #2015-107 OF THE LUMMI INDIAN BUSINESS COUNCIL

TITLE: Adoption of the 2015 Lummi Nation Multi-Hazard Mitigation Plan

WHEREAS, the Lummi Indian Business Council (LIBC) is the duly constituted governing body of the Lummi Nation by the authority of the Constitution and By-laws, as amended, of the Lummi Tribe of the Lummi Reservation, Washington; and

WHEREAS, it is the mission of the LIBC *"To Preserve, Promote and Protect our Sche Lang en"* (LIBC Resolution #2012-025); and

WHEREAS, pursuant to Article VI(l) of the Lummi Constitution, the LIBC is required to safeguard and promote peace, safety, and welfare of the Lummi People and the Lummi Reservation community; and

WHEREAS, the LIBC is responsible for the protection, restoration, enhancement, and management of the natural resources within the exterior boundaries of the Lummi Reservation and throughout the Lummi Nation's Usual and Accustomed (U&A) fishing and gathering grounds and stations and traditional territories; and

WHEREAS, natural hazard events have occurred in the past and larger events can be expected to occur in the future on and near the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, defined hazard management policies and a coordinated hazard management plan, with a focus on the homeland, will reduce the impacts of natural hazard events on the Lummi Reservation and within the Lummi Nation's U&A; and

WHEREAS, the LIBC adopted the Lummi Nation Multi-Hazard Mitigation Plan by Resolution #2004-015 on January 19, 2004 as recommended by the Lummi Fisheries and Natural Resources Commission, the Lummi Nation Natural Resources Department Director, the Lummi Planning Commission, and the Lummi Law and Justice Commission, and directed that a Multi-Hazard Mitigation Team be established; and

WHEREAS, the LIBC adopted the 2007 update of the Lummi Nation Multi-Hazard Mitigation Plan by Resolution #2007-060 on April 16, 2007 as recommended by the Lummi Multi-Hazard Mitigation Team, the Lummi Fisheries and Natural Resources Commission, the Lummi Nation Natural Resources Department Director, the Lummi Planning Commission, and the Lummi Law and Justice Commission; and

WHEREAS, the LIBC adopted the 2010 update of the Lummi Nation Multi-Hazard Mitigation Plan by Resolution #2010-093 on May 25, 2010 as recommended by the Lummi Multi-Hazard

Mitigation Team, the Lummi Fisheries and Natural Resources Commission, the Lummi Planning Commission, the Lummi Law and Justice Commission, and the Lummi Cultural Commission; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan identifies proposed actions for hazard preparedness and damage reduction, and recommends priorities for natural hazard mitigation; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan was developed in compliance with the Stafford Act and FEMA regulations and allows the Lummi Nation to be eligible for certain hazard mitigation and disaster response funding sources; and

WHEREAS, to remain eligible for these funding sources, FEMA has required the plan to be updated every five years to reflect changes in development, progress in mitigation efforts, and changes in priorities and to be resubmitted to the FEMA Regional Director; and

WHEREAS, members of the Lummi Multi-Hazard Mitigation Team met on August 20, 2015 to review and discuss potential changes to the 2010 plan, provide input on the update, and recommended that the updated plan be presented to the LIBC; and

WHEREAS, continued implementation of the Lummi Nation Multi-Hazard Mitigation Plan will reduce natural hazard-related damages, reduce environmental impacts of hazard mitigation activities, and reduce the long-term costs of hazard mitigation; and

WHEREAS, the Lummi Nation Multi-Hazard Mitigation Plan is consistent with the Flood Damage Prevention Code (Title 15A Lummi Nation Code of Laws), the Land Use, Zoning, and Development Code (Title 15 Lummi Nation Code of Laws), the Building Code (Title 22 Lummi Nation Code of Laws), and the Water Resources Protection Code (Title 17 Lummi Nation Code of Laws).

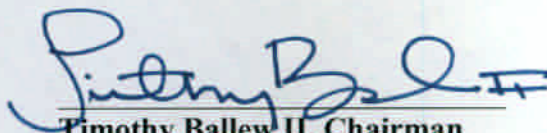
NOW, THEREFORE, BE IT RESOLVED, that the LIBC adopts the 2015 Lummi Nation Multi-Hazard Mitigation Plan; and

BE IT FURTHER RESOLVED, that the LIBC authorizes the Multi-Hazard Mitigation Team to continue its work and directs the General Manager or his designee to coordinate the ongoing staffing and operations of this team and to ensure its effectiveness; and

BE IT FURTHER RESOLVED, that the LIBC directs the Multi-Hazard Mitigation Team to update the plan every five years consistent with FEMA guidance; and

BE IT FINALLY RESOLVED, that the Chairman (or Vice Chair in his absence) is hereby authorized and directed to execute this resolution and any documents connected therewith, and the Secretary (or the Recording Secretary in his absence) is authorized and directed to execute the following certification.

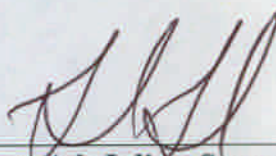
LUMMI NATION



Timothy Ballew II, Chairman
Lummi Indian Business Council

CERTIFICATION

As Secretary of the Lummi Indian Business Council, I hereby certify that the above Resolution #2015-107 was adopted at a **Regular/Special** Meeting of the Council held on the 1st day of September, 2015, at which time a quorum of 9 was present by a vote of 8 for, 0 against, and 0 abstention(s).



Jeremiah Julius, Secretary
Lummi Indian Business Council



APPENDIX B

PowerPoint Presentation on the Multi-Hazard Mitigation Plan to the Multi-Hazard Mitigation Team (August 20, 2015) and the Lummi Indian Business Council (September 1, 2015).

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SUMMARY OF FINDINGS AND RECOMMENDATIONS



Lummi Nation Multi-Hazard Mitigation Plan: 2015 Update

Presentation to:
Multi-Hazard Mitigation Team – August 20, 2015
Lummi Indian Business Council – September 1, 2015

Presentation Outline



- Hazard mitigation planning in context
- Goals and objectives of the Lummi Nation Multi-Hazard Mitigation Plan (MHMP)
- 2015 update to the MHMP
- Recommendations of the MHMP

Hazard Mitigation Planning



- Natural hazard events have occurred on and near the Reservation in the past and larger events can be expected to occur in the future
- The purpose of the MHMP is to:
 - Guide current and future efforts to effectively and efficiently mitigate the impacts of natural hazards on the Reservation
 - Guide efforts to mitigate and respond to natural hazards that are generated off-Reservation or that cross Reservation boundaries in coordination with other agencies as appropriate

Hazard Mitigation Planning



- The MHMP has been developed and updated pursuant the requirements of 44 CFR Part 201 and amendments thereto
 - 2004 MHMP adopted by LIBC Resolution No. 2004-015
 - 2007 MHMP adopted by LIBC Resolution No. 2007-060
 - 2010 MHMP adopted by LIBC Resolution No. 2010-093
- Updates to and continued implementation of the MHMP makes the Lummi Nation eligible for certain types of assistance under the Stafford Act and Nation Flood Insurance Act

Goals and Objectives



- The goals of the MHMP are to:
 - Reduce the threats to public health and safety posed by natural hazards
 - Reduce structural damages caused by natural hazards
 - Reduce the environmental impacts of natural hazards, mitigation actions, and future development activities including impacts to cultural properties
 - Reduce the long-term costs resulting from natural hazards and their mitigation
- There were no substantive changes to the MHMP goals and objectives in the 2015 update

2015 Vulnerability Assessment



- The Reservation remains vulnerable to the following natural hazards:

• Floods	• Wildfires
• Earthquakes	• Landslides
• Severe winter storms	• Tsunami
• Windstorms	• Volcanic eruptions
• Coastal erosion	• Tornadoes
• Drought	
- There were no substantive changes to the hazard vulnerability rankings in the 2015 update



2010-2015 Hazard Events

- Examples of hazard events that occurred on the Reservation over the 2010-2015 period include the following:
 - December 8-18, 2010 – severe winter storm
 - December 13, 2010 – Nooksack River flood
 - December 10, 2011 – coastal floods
 - January 14-19, 2012 – severe winter storm
 - December 9, 2014 – windstorm and coastal floods
 - December 11, 2014 – windstorm
 - July 4, 2015 – wildfire
 - April 2015 to present – drought



2010-2015 Mitigation Actions

- Examples of mitigation actions over the 2010-2015 period include the following:
 - Ongoing formal MHMT meetings and informal MHMT subcommittee meetings
 - Acquisition and removal of two flood-prone structures with Hazard Mitigation Grant Program (HGMP) funds (2010) – one on the Sandy Point Peninsula and one along Haxton Way
 - Smuggler's Slough Restoration Project – included Marine Drive elevation and acquisition and removal of one flood-prone structure (2011)
 - Lummi Nation Forest Management Plan updated (2011)



2010-2015 Mitigation Actions

- Examples of mitigation actions over the 2010-2015 period include the following: (cont.)
 - Community Assistance Visit (CAV) with FEMA evaluated the Lummi Nation's compliance with the National Flood Insurance Program (NFIP) (2012)
 - Coastal Flood Study (RiskMAP) Partnership Agreement signed (2013)
 - Community Rating System (CRS) Community Verification Visit (CVV) – CRS rating improved to a Class 7, which increased flood insurance premium discounts in Special Flood Hazard Areas (SFHAs) to 15 percent (2013)
 - 9-1-1 Addressing Project implemented on the Lummi Peninsula and portions of the floodplain (2013)



2010-2015 Mitigation Actions

- Examples of mitigation actions over the 2010-2015 period include the following: (cont.)
 - LIBC Emergency Notification Text Messaging System developed (2014)
 - Lummi Nation Comprehensive Emergency Management Plan updated and associated trainings and drills conducted (2015)
 - Draft Assessment of Climate Change Impacts on the Lummi Indian Reservation developed (2015)
 - Ongoing public outreach and education – included Safe Streets Walks, Community Emergency Response Team (CERT) trainings, Squol Quol articles



Additional MHMP Updates

- Examples of additional updates to the 2015 MHMP include the following:
 - Updated description of the Reservation (e.g., population, socioeconomic conditions, emergency response capabilities, environmental conditions)
 - Updated structure valuation information and potential losses estimates
 - Updated description of climate change impacts to existing natural hazards (e.g., coastal and riverine floods, coastal erosion, drought, wildfires, landslides)



Findings and Recommendations

- Natural hazards on the Reservation have a direct, serious, and substantial effect on the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation
- Further, those activities that potentially increase the frequency or severity of damages from natural hazards, if left unregulated or unaddressed, will eventually cause such damages
- Recommend adoption of the 2015 MHMP update and continued implementation of the MHMP action plan



Questions?

APPENDIX C

Lummi Nation Comprehensive Emergency Management Plan

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LUMMI NATION COMPREHENSIVE EMERGENCY MANAGEMENT PLAN



June 30, 2015



June 30, 2015

To: Lummi Nation
From: Chief Ralph Long
Subject: Lummi Nation Comprehensive Emergency Management Plan

The Lummi Nation considers the safety of its residents, visitors, employees, students, the public, and clients of the utmost importance. In this regard, the Lummi Nation has published this Lummi Nation Comprehensive Emergency Management Plan.

This document is a continually evolving document and will be updated on a regular basis, at least annually.

As part of this plan, the Lummi Nation will also be conducting periodic drills, exercises and workshops to ensure that the elements outlined in this plan are in familiar and part of the daily work environment.

Members of the Lummi Nation are urged to submit suggestions, concerns, or ideas anytime to the Lummi Nation Police Department.

Thank you,

Ralph Long, Chief, Lummi Nation Police Department



TABLE OF CONTENTS

RECORD OF CHANGES.....	5
INTRODUCTION.....	6
PURPOSE.....	6
SCOPE	6
LIMITATIONS.....	7
EMERGENCY POWERS	8
DECLARATION OF EMERGENCY	8
COMMAND AND CONTROL.....	8
<i>Emergency Authority</i>	8
<i>Emergency Contracts</i>	8
LAWS AND AUTHORITIES.....	8
COORDINATION WITH LOCAL, STATE & FEDERAL AGENCIES.....	9
LOCATIONS	9
<i>Lummi Nation</i>	9
<i>City Of Ferndale</i>	10
<i>Lummi Island</i>	10
SERVICES.....	10
<i>Lummi Nation</i>	10
<i>Fire & Ems Services</i>	10
<i>Law Enforcement Services</i>	11
<i>Public Health Services</i>	11
<i>Community Services</i>	11
CONCEPT OF OPERATIONS	12
NATIONAL INCIDENT MANAGEMENT SYSTEM (NIMS)	12
LEVELS OF EMERGENCY	12
PLAN ACTIVATION.....	12
LUMMI NATION EMERGENCY COORDINATION CENTER (LNECC)	13
ESSENTIAL OPERATIONS.....	15
INCIDENT COMMAND SYSTEM (ICS)	16
UNIFIED COMMAND REPRESENTATIVE / INCIDENT COMMANDER	18
COMMAND STAFF	20
<i>Liaison Officer (LNO)</i>	20
<i>Safety Officer (SO)</i>	22
<i>Public Information Officer (PIO)</i>	23
<i>Legal Officer (LO)</i>	24
GENERAL STAFF.....	25
<i>Operations Section</i>	25



<i>Planning Section</i>	27
<i>Logistics Section</i>	28
<i>Finance/Administration Section</i>	29
ASSIGNMENT OF GENERAL RESPONSIBILITIES	31
ASSIGNMENT OF DEPARTMENT SPECIFIC RESPONSIBILITIES	32
<i>Lummi Nation Tribal Council – Policy</i>	32
<i>Legal Counsel - Liaison</i>	32
<i>Chairman</i>	32
<i>Chairman/Director Of Public Information</i>	33
<i>Director, Lummi Community Services</i>	33
<i>Director Of Facilities And Maintenance - Logistics</i>	33
<i>Director For Human Resources – Human Resources</i>	33
<i>Lummi Nation Police Department – Plan Development</i>	34
<i>Director, Lummi Nation Accounting</i>	34
<i>Information Systems Manager</i>	34
<i>Accounting – Risk Management</i>	35
<i>Site Directors And Managers</i>	35
<i>Director Of Planning – Structural Mitigation/Damage</i>	35
APPENDIX 1 – LUMMI NATION ORGANIZATIONAL CHART	36
APPENDIX 2 – LUMMI NATION ICS ORGANIZATION	37
APPENDIX 3 – EMERGENCY NUMBERS	38
APPENDIX 4 – ACCOUNTABILITY CHECKLIST	39
APPENDIX 5 – SUSPICIOUS PERSON GUIDELINES	40
APPENDIX 6 - ASSAULT INCIDENT GUIDELINES	41
APPENDIX 7 – LOSS OF BUILDING INFRASTRUCTURE GUIDELINES	42
APPENDIX 8 – CHILD INCIDENT GUIDELINES	43
APPENDIX 9 – ACTIVE SHOOTER GUIDELINES	44
APPENDIX 10 – EARTHQUAKE GUIDELINES	45
APPENDIX 11 – FIRE/FIRE ALARM GUIDELINES	46
APPENDIX 12 – FLOODING GUIDELINES	47
APPENDIX 13 – HAZARDOUS MATERIALS GUIDELINES	48
APPENDIX 14 – HOSTAGE TAKING GUIDELINES	49
APPENDIX 15 –PANDEMIC GUIDELINE	50



RECORD OF CHANGES

NOTICE TO PLAN HOLDERS: In order to maintain a current Lummi Nation Risk, Safety, Security Emergency and Crisis Management Plan, the Lummi Nation Police Department will issue changes periodically. Please make those changes upon receipt, and record them on this page. If a previous change number shows no entry you may not have an up-to-date version of the plan.

CHANGE #	DATE MADE	LOCATION/PAGE (S) CHANGED	INITIALS
01			
02			
03			
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Lummi Nation

Comprehensive Emergency Management Plan

INTRODUCTION

Disruptive events can happen suddenly, creating a situation in which the normal staff support services for the Lummi Nation can become overwhelmed. During these events, the Lummi Nation requires special programs to address the needs of response operations and recovery management. To address disruptive events, the Lummi Nation has established this Risk, Safety, Security, Emergency & Crisis Management Plan, which is the framework for the management of the immediate actions and operations required to respond to, and recover from, a disruptive event. The overall priorities of the Lummi Nation during a disaster are the protection of lives, property, the community, and the environment. The overall objective is to effectively respond to disruptive events in a safe manner and manage the process of restoring Lummi Nation programs and services.

PURPOSE

This plan provides the management structure, key responsibilities, assignments, and general procedures to follow during and immediately after a disruptive event. The Lummi Nation has established this plan to address the immediate requirements for a major disaster or emergency in which normal operations are interrupted and special measures must be taken to:

- Save and protect the lives of the residents, visitors, employees, students, the public, and clients both living and working in Lummi Nation facilities and the Lummi Indian Reservation;
- Manage immediate communications and information regarding response operations and safety;
- Provide essential services and operations;
- Provide and analyze information to support decision-making and action plans;
- Manage Lummi Nation resources effectively in the emergency response.

This plan does not supersede or replace the procedures for safety or other procedures that are already in place at the Lummi Nation. It supplements those procedures with a management structure that provides for the immediate focus of management of response operations and the transition to recovery operations.

SCOPE

This plan applies to the residents, visitors, employees, students, the public, and clients of the Lummi Nation. Where other agencies and institutions are mentioned, the plan describes understandings or agreements about their expected actions.



Whatcom County, the State of Washington, and the U.S. Federal Emergency Management Agency (FEMA) maintain separate emergency plans and operations. In general, during emergencies the Lummi Nation may request assistance from the other jurisdictions when its response resources are depleted, or the incident characteristics require outside expertise and/or legal notifications/response from other local, state or federal agencies.

During any type of disruptive event, the Lummi Nation is responsible for coordinating operations within its facilities on and off of the Reservation.

For the purposes of this plan, the term “disruptive event” means an event that will: (1) present a real immediate threat to the proper performance of essential functions, (2) will likely result in material loss or damage to property, bodily injury, or loss of life, or (3) will likely result in a significant economic impact. A disruptive event may, or may not, mean the situation is beyond the capabilities of the Lummi Nation to respond to.

This plan is consistent with the National Response Framework (NRP), the Washington State Comprehensive Emergency Management Plan, and the Whatcom County Comprehensive Emergency Management Plan.

In all disruptive events, Lummi Nation efforts will proceed according to these priorities:

1. Eliminate major threats to life and safety.
2. Maintain essential management continuity.
3. Protect critical assets.
4. Eliminate major threats to public and private property.
5. Protect the environment.
6. Restore essential systems and services.
7. Minimize economic disruption.
8. Restore normal business and management operations.

LIMITATIONS

The diverse nature of any emergency or disaster makes it likely no single management agency or jurisdiction can handle all potential incidents alone. It is neither implied nor inferred that this plan guarantees a perfect response. No plan can shield individuals from all events. While every reasonable effort will be made to respond to disruptive events, resources and/or systems may be overwhelmed. Some events provide little or no warning to implement operational procedures, and all emergency plans are dependent upon tactical execution that may be imperfect.



EMERGENCY POWERS

DECLARATION OF EMERGENCY

The Chairman or designee has the sole authority to make a Declaration of Emergency for the Lummi Nation.

COMMAND AND CONTROL

The Police Chief or designee has the power to direct Lummi Nation staff responses, and decide questions of internal authority and responsibility.

EMERGENCY AUTHORITY

The responsibility for all administration and Lummi Nation operations rests with the Police Chief.

In the case of absence, the Chairman may designate one or more senior Lummi Nation staff to act in the place of the Police Chief with regard to the power and duties required for response to an emergency.

EMERGENCY CONTRACTS

When any disruptive event shall require the immediate execution of a contract, the Treasurer or designee is authorized to execute any contract for acquisition of materials, equipment, supplies, and services necessary to respond to the existing disruptive event at an amount not to exceed their sole spending authority.

LAWS AND AUTHORITIES

This plan is established under the following laws and authorities:

- Lummi Nation Resolution #2015-086
- Memorandum of Understanding Between the Lummi Nation and the Whatcom County Health Department Relating to Disease and Contamination Control Measures
- Emergency Planning & Community Right to Know Act
- Sandy Recovery Improvement Act of 2013
- Public Law 93-288 as amended by Public Law 100-707 Robert T. Stafford Disaster Relief and Emergency Assistance Act
- Federal Civil Defense Act of 1950, as amended
- Tribal Relations Support Annex to National Response Plan
- Lummi Nation Spill Prevention and Response Plan
- Local Operating Plan Relating To Bureau of Indian Affairs/Department of Natural Resources Offset and Other Agreements (Fire Protection Services Operating Agreement)



COORDINATION WITH LOCAL, STATE & FEDERAL AGENCIES

LOCATIONS

LUMMI NATION

The Lummi Nation is a Self-Governing Nation within the United States established by the Treaty of Point Elliot in 1855. It is the third largest tribe in Washington State, serving over 5,000 members. The Lummi Nation manages nearly 20,000 acres of uplands and tidelands on the Lummi Reservation with civil jurisdiction over its usual and accustomed grounds. The Administrative Offices are located at 2665 Kwina Road, Bellingham, WA 98226.

The Lummi Nation owns, leases or works in numerous properties in Whatcom County including the City of Ferndale, Un-Incorporated Whatcom County, and the Lummi Indian Reservation. In Whatcom County the Lummi Nation facilities currently owns multiple properties.

Local response organizations and the Lummi Nation have adopted the NIMS Incident Command System as the standard for management of disruptive events.

The Lummi Nation Police Department, the Whatcom County Sheriff's Office, and other Whatcom County Fire Departments, are the primary response agencies for incidents at the Lummi Reservation. The Department of Emergency Management (DEM) is responsible for maintaining the Whatcom County Comprehensive Emergency Management Plan. Under the Plan they will coordinate disaster operations and resource assistance in support of the Lummi Nation. In addition to assisting with on-scene response for disruptive events:

- The Lummi Nation Police Department may open an Emergency Operation Center (EOC) in their headquarters building. The primary location is at 2665 Kwina Road, Bellingham, WA 98226.
- The Whatcom County Sheriff's Office DEM may open an Emergency Operation Center (EOC) in any number of locations appropriately sized for the magnitude of the disaster. The primary location would likely be at Whatcom Unified Emergency Management (3888 Sound Way, Bellingham, WA 98225).
- The State of Washington Emergency Management Division (EMD) maintains an EOC at Camp Murray in Tacoma. It is responsible for maintaining the state Comprehensive Emergency Management Plan and for coordinating with local emergency management agencies and obtaining outside resources.
- The Federal Emergency Management Agency (FEMA) provides emergency management services and resource management under the National Response Plan. FEMA Region X maintains an EOC in Bothell.

The Lummi Nation has properties, infrastructure and operational facilities within the boundaries of multiple jurisdictions.



CITY OF FERNDALE

Ferndale Police has jurisdictional law enforcement responsibilities within the City of Ferndale limits while Whatcom County Fire District #7 has responsibility for response fire, hazardous material and emergency medical service incidents. The Washington State Patrol maintains Incident Command at Hazardous Materials Incidents in Ferndale.

LUMMI ISLAND

On Lummi Island the Whatcom County Sheriff's Department have jurisdictional law enforcement responsibilities while Whatcom County Fire District #8 has responsibility for response fire, hazardous material and emergency medical service incidents. The Washington State Patrol maintains Incident Command at Hazardous Materials Incidents on Lummi Island.

SERVICES

LUMMI NATION

On the Lummi Indian Reservation and on other lands owned by the Lummi Government, the Lummi Nation Police Department have jurisdictional law enforcement responsibilities while Whatcom County Fire District #7, #8 and #17 have responsibility for response to fire, hazardous material and emergency medical service incidents. Depending on the specific incident, Incident Command for Hazardous Materials incidents within the boundaries of, or affecting the Lummi Nation, The Environmental Protection Agency (EPA), the U.S. Coast Guard, Washington State Department of Ecology, Region 10 Regional Response Team, or other agencies will, depending on the location, maintain Incident Command of Hazardous Materials Incidents within Lummi Nation boundaries but at a minimum this will be coordinated through and with the Lummi Natural Resources Department.

FIRE & EMS SERVICES

Typical responsibilities of Whatcom County Fire Services include:

- Establishment and staffing of Incident Command;
- Fire suppression;
- Emergency Medical Services (*While all Whatcom County Fire Services have responsibilities for Basic Life Support (BLS) EMS service, the Whatcom Medic One program administered by the Bellingham Fire Department is responsible for county-wide Advanced Life Support (ALS) EMS service*);
- Specialized rescue services;
- Request necessary personnel and equipment in accordance with existing mutual aid agreements and the State Resource Mobilization Plan;
- Establish liaison with the responding police department for landside traffic and crowd control, scene security, and evacuation;
- Hazardous materials response (*All Whatcom County Fire Services have the ability to provide basic defensive response to hazardous materials incidents. Higher-level offensive responses are referred to the Specialized Emergency Response Program (SERP) Hazmat Unit or to private contractors.*)



LAW ENFORCEMENT SERVICES

In addition to expected law enforcement activities, specialized response capabilities include:

- Boat and Dive Teams;
- Bomb disposal;
- Crisis negotiations;
- Criminal investigations;
- Crowd control;
- K-9 response;
- Special Response Teams

The Federal Bureau of Investigation (FBI) is the investigative arm of the U.S. Department of Justice (DOJ). The FBI's investigative authority can be found in Title 28, Section 533 of the U.S. Code.

PUBLIC HEALTH SERVICES

The Lummi Nation provides health services through its Lummi Tribal Health Center in cooperation with the Northwest Washington Indian Health Board and the Whatcom County Public Health Department that is tasked with response to public health incidents affecting populations within Whatcom County. The Lummi Tribal Health Center shall be responsible for coordination and facilitation of any response by Public Health authorities to events within the Lummi Nation jurisdictional boundaries.

COMMUNITY SERVICES

The Lummi Nation provides community services through its Lummi Tribal Community Services. Community Services is tasked with managing food sources, energy resources, food management during disruptive events, manages emergency worker and clients needs for food preparation, provides transportation to feed, house, or assist clients during inclement weather and works with Natural Resources to develop and update vulnerable population mapping within the Lummi Nation jurisdictional boundaries.



CONCEPT OF OPERATIONS

NATIONAL INCIDENT MANAGEMENT SYSTEM (NIMS)

The NIMS provides a consistent nationwide template to enable Federal, Tribal, State, Local, and private-sector and non-governmental organizations (NGOs) to work together effectively and efficiently to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of catastrophic terrorism.

NIMS is comprised of several components that work together as a system:

- Command and Management
- Preparedness
- Resource Management
- Communications and Information Management
- Supporting Technologies
- Ongoing Management and Maintenance

LEVELS OF EMERGENCY

Emergency conditions vary with each incident. As a guide, three levels of emergency are specified, as follows:

1. Level 1 Disruptive Event is handled within the Lummi Nation by “normal” checklists and/or response activities. While there may be some damage and/or interruption, the conditions are localized and the Lummi Nation can coordinate and manage the event and site of the event remains open. Implementation of the Lummi Nations internal Notification Policy should be considered (see Notifications on page 14).
2. Level 2 Disruptive Event exceeds the capabilities of the Lummi Nation to manage the event and the disruptive event causes damage and/or interruption to Lummi Nation operations. The Lummi Nation may be the only affected entity but outside resources are needed to stabilize or mitigate the emergency. On-scene command should be established. Activation of the Lummi Nation Emergency Team may or may not be needed. The Lummi Nation’s internal Emergency Notification Policy must be implemented (see Notifications page 14). The situation must be monitored with regular situation reports issued.
3. Level 3 – Disruptive Event exceeds the capacity of the Lummi Nation to address immediate emergency response. The event may involve a single location or may be widespread. The Lummi Nation may need to be self-sufficient for a period of hours to several days. The Lummi Nations internal Emergency Notification Policy must be implemented (Notifications see on page 14).

PLAN ACTIVATION

This plan is activated whenever disruptive events occur in which normal operations cannot be performed and immediate action is required to:



1. Eliminate major threats to life and safety.
2. Eliminate major threats to public and private property.
3. Protect the environment.
4. Maintain essential management continuity.
5. Protect critical assets.
6. Restore essential systems and services.
7. Minimize economic disruption.
8. Restore normal business and management operations.

LUMMI NATION EMERGENCY COORDINATION CENTER (LNECC)

The Lummi Nation Police Department (2665 Kwina Road, Bellingham, WA) is designated as the primary Emergency Coordination Center for the Lummi Nation. The room has sufficient infrastructure to accommodate the data hubs and telecommunications needed in an Emergency Coordination Center.

The Lummi Nation does not currently have an alternate Emergency Coordination Center formally identified. Other possible alternate locations include the Silver Reef Casino Hotel and Spa (4876 Haxton Way, Ferndale, WA) or the Northwest Indian College (2522 Kwina Road, Bellingham, WA).



INITIAL NOTIFICATIONS

For the purposes of this Plan, any Level 2 or Level 3 Disruptive Event needs to be reported that:

1. Presents a real immediate threat to the proper performance of essential Lummi Nation functions, or;
2. Will likely result in material loss or damage to property, bodily injury, or loss of life if immediate action is not taken, or;
3. Has a likelihood of attracting media attention.

It is Lummi Nation policy that upon the discovery of a disruptive event that immediate actions to mitigate or stabilize the event will be undertaken to the best of the ability of the person(s) witnessing the disruptive event. This includes, but is not limited to, rendering first aid and/or calling 911.

At the first opportunity, if the reporting person is an employee, the employee must report the emergency directly to their immediate supervisor. The supervisor is responsible for ensuring the emergency is reported via voice to the following as soon as practical:

1. Lummi Nation Police Department
2. Chairman's Office
3. General Manager's Office
4. The Chairman or designee will notify and update Council members and affected Commissions.

In the event that any supervisor or director is not available, the reporting individual will make notification to the next highest level in the Chain of Command (e.g. in the absence of a supervisor, the reporting party will make notification to Lummi Nation Police Department. If the Lummi Nation Police Department is also unavailable, notification will be made directly to the Chairman's Office). Leaving a voice-mail does not constitute an acceptable notification.

The supervisor / manager or their designees must ensure that additional notifications are made in accordance with any site or incident specific plans or regulatory requirements.

Whenever a disruptive event occurs, all necessary efforts should be made to protect human life, then property and then the environment, without endangering employees or the general public. As soon as possible after the emergency measures have been taken, the employee in charge is to ensure that a full written report is provided to the Lummi Nation Police Department. Broader notifications may be made via the Lummi Nation text notification system.



ESSENTIAL OPERATIONS

The following are regarded as essential internal operations of the Lummi Nation during disruptive events:

1. Command, Control & Communications
2. Logistical /Maintenance Operations
3. Finance & Administration
4. Legal Counsel

INCIDENT COMMAND SYSTEM (ICS)

The Incident Command System is designed to enable effective and efficient incident management by integrating facilities, equipment, personnel, procedures, and communications to operate within a common organizational structure. The ICS can be used to organize operations for a wide spectrum of emergency incidents, near-term and long-term, from small to complex, whether natural or man-made. All levels of government and NGOs responding to Lummi Nation disruptive events use ICS. The system is flexible and provides for the inclusion of private-sector representation that may not be familiar with the principles of Incident Command. The ICS is normally structured to facilitate the activities in five functional sections: Command, Operations, Planning, Logistics, and Finance/Administration.

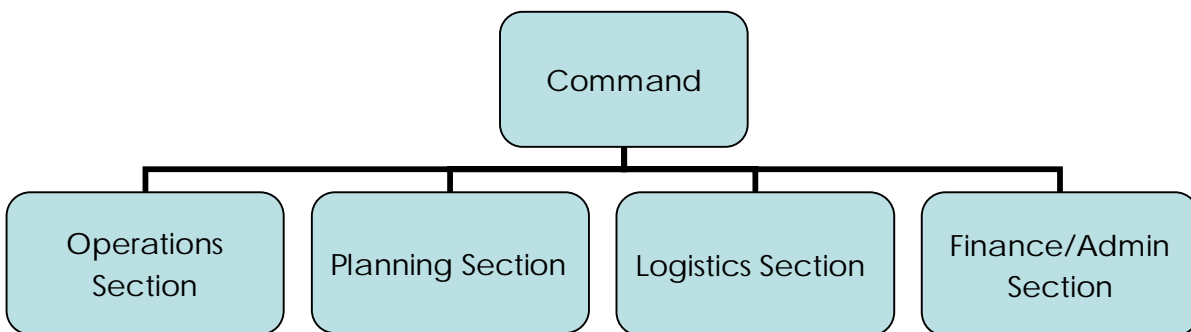


Figure 1 - Incident Command System Functional Structure

Unified Command is the application of this same functional structure during a multi-jurisdictional, multi-agency/organization response. A Unified Command overcomes much of the inefficiency and duplication of effort that can occur when a diverse response community operates without a common system or organizational framework. Under a Unified Command, representatives of the various groups work together to determine incident response objectives, strategies and priorities. This teamwork method is accomplished without affecting individual entity authority, responsibility or accountability. Whenever possible, decisions with regard to the response will be made by consensus and documented through a single Incident Action Plan (IAP). When a consensus cannot be reached, the agency commander with the primary responsibility under the circumstances will have ultimate decision-making authority.

There are three possible ways that the Lummi Nation may be involved with Incident Command System (ICS) structures:

- An outside agency such as a fire department may respond to an incident on Lummi Reservation property with Lummi Nation personnel interacting as “agency representatives” with the outside agency’s ICS structure.
- The Lummi Nation may provide personnel to serve in various ICS positions at an On-Scene Command Post, in a city or county Emergency Operation Center.
- The Lummi Nation may initiate the ICS in its own On-Scene Command Post and/or Emergency Coordination Center.



Jurisdictional agencies and organizations that may be involved in the Unified Command structure during an emergency incident with the Lummi Nation include:

Tribal Agencies / Authorities

- Tribal On-Scene Coordinator (TOSC)
- Lummi Natural Resources
- Lummi Nation Police Department
- Office of the Chairman
- Lummi Tribal Health
- Northwest Indian Health
- Indian Health Services
- Other Tribal Government Representatives

Federal Agencies / Authorities

- Federal On-Scene Coordinator (FOSC)
- Center for Disease Control (CDC)
- Environmental Protection Agency (EPA)
- Federal Bureau of Investigation (FBI)
- Federal Emergency Management Agency (FEMA)
- U.S. Customs and Border Protection (CBP)
- U.S. Coast Guard (USCG)
- U.S. Immigration and Customs Enforcement (ICE)
- U.S. Army Corps of Engineers (COE)

State Agencies / Authorities

- State On-Scene Coordinator (SOSC)
- Washington State Office of Superintendent of Public Instruction (OSPI)
- Washington State Department of Social & Health Services (DSHS)
- Washington State Department of Public Health (DOH)
- Washington State Emergency Management Division (EMD)
- Washington State Department of Ecology (DOE)
- Washington State Labor and Industries (L&I)
- Washington State Patrol (WSP)

Local Jurisdictional Response Agencies / Authorities

- Local On-Scene Coordinator (LOSC)
- Bellingham Fire Department / Medic One
- Ferndale Police Department
- Whatcom County Division of Emergency Management (DEM)
- Whatcom County Fire Districts #7, #8 and #17.
- Whatcom County Health Department
- Whatcom County Medical Examiner
- Whatcom County Sheriff's Office (WCSO)
- Lummi Nation Police Department

Local Non-Governmental Organizations (NGOs)

- American Red Cross Mount Baker Chapter (ARC)



- Business Owner / Operators
- Kinder-Morgan
- BP Cherry Point
- Phillips 66
- Puget Sound Energy (PSE)
- Burlington Northern Santa Fe (BNSF)
- Peace Health St. Joseph Hospital

UNIFIED COMMAND REPRESENTATIVE / INCIDENT COMMANDER

The Lummi Nation Command Representative represents the Lummi Nation in the Unified Command and/or when appropriate serves as the Incident Commander (IC).

The Chairman, or appropriate delegate, is responsible for all incident management at the Lummi Nation. This responsibility is delegated to department directors who delegate the responsibility to operational managers. The first person on-scene is responsible for initiating command. As long as successive levels of management are satisfied that the incident is being well managed, they may continue to monitor events. It is critical that all levels of management are kept aware of the incident details, objectives and management. Management may assume command at anytime. If a transfer of command occurs, it must be communicated to all on-scene response and to incoming response.

The transfer of command is best accomplished when done face-to-face with the outgoing Incident Command. It should include a briefing that covers:

- Incident history (what has happened)
- Priorities and objectives
- Current plan
- Resource assignments
- Incident organization
- Resources ordered/needed
- Facilities established
- Status of communications
- Any constraints or limitations
- Incident potential

Incident Commander Responsibilities:

- Responsible for incident management and coordination;
- Initiate and maintain an incident position log;
- Establish and announce the Command Post (CP) location;
- Validate incident assessment and determine scale of Lummi Nations's response;
- Ensure all required internal and external notifications have been made;
- Assign personnel to appropriate Command and General staff positions;
- Establish incident operational periods and objectives;
- Implement sufficient resources to achieve the objectives for the operational period;
- Provide incident response guidance to tenant(s);



- Facilitate communications between the Command Post and the Lummi Nation Emergency Coordination Center (if activated).

Primary: Lummi Nation Police Chief or designee

Alternate: Director of the department responsible for location where incident is occurring or building administrator of the location where incident is occurring

Applicable Checklists: Facility specific Plans and/or Checklists, Incident Command Position Checklist as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide, and External Notifications Policy

COMMAND STAFF

In an Incident Command / Unified Command structure, command staff consists of various special purpose staff positions. The special staff positions are specifically designated, report directly to the Incident Commander, or Unified Command, and are assigned responsibility for key activities that are not a part of the general staff functional elements. Typically, three special staff positions are utilized during a major incident: Safety, Liaison, and Public Information. For the purposes of this plan a Legal Officer has been added to the command staff. The command staff positions may be activated as needed for Lummi Nation disruptive events or to be assigned to multi-agency Unified Command structures.

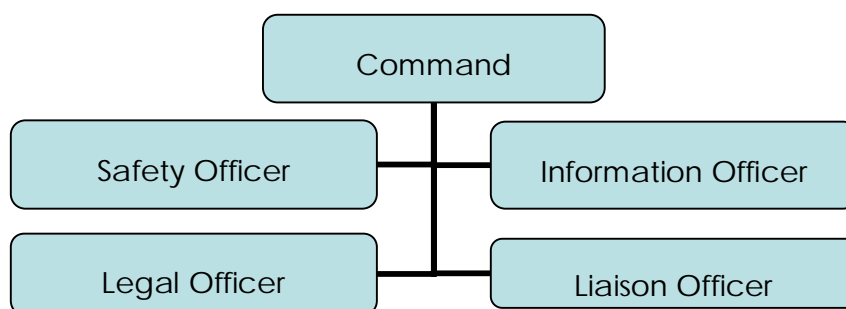


Figure 2 - Incident Command System Command Staff

LIAISON OFFICER (LNO)

The Liaison Officer is the initial point of contact for representatives of other governmental agencies, NGOs and/or private entities. Representatives from responding agencies and organizations coordinate through the LNO. Assistants and personnel from other agencies or organizations may be assigned to the LNO to facilitate interagency coordination.

In large responses, the Lummi Nation may assign an appropriate Liaison to another Emergency Operations Center, Coordination Center or Command Post to represent the Lummi Nation's interests and to keep the Lummi Nation informed of incident developments.

LNO Responsibilities:

- Oversee all liaison activities, including coordinating outside agency representatives assigned to the incident;
- Initiate and maintain an incident position log;
- Establish and maintain a central location for incoming agency representatives, providing workspace and support as needed;
- Ensure that position specific checklists, directives, situation reports and a copy of the current Incident Action Plan (IAP) is provided to agency representatives upon check-in;

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- Maintain a contact roster of agency representatives not assigned to specific sections of the Incident Command System;
- In coordination with Incident Command and security, provide orientations for VIPs and other visitors to the Emergency Operations Center, Coordination Center or Command Post.

Primary: Manager, Director or Supervisor of Affected Location

Alternate: Department Manager

Applicable Checklists: Liaison Officer Checklist as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide



SAFETY OFFICER (SO)

The safety of staff and personnel from responding agencies is a high priority objective. The Safety Officer advises Command on all matters relating to operational safety, including the health, safety and accountability of the emergency response personnel. A Safety Officer may not be necessary for every scene or in the Emergency Operations Center, Coordination Center or Command Post. Command, however, should strongly consider appointing a Safety Officer when an on-scene incident has or could develop health or safety hazards. Unless delegated, the scene safety remains the responsibility of the Command.

Depending on situational hazards and/or responding agencies, the Safety Officer may be selected from operational Lummi Nation staff that is most familiar with the health and safety hazards of the incident. Responding agencies often will designate a Safety Officer who may need technical assistance from knowledgeable Lummi Nation staff.

Safety Officer Responsibilities:

- Organize, assign tasks and supervise all personnel mobilized to support the safety functions;
- Implement procedures necessary to ensure ongoing assessment of hazardous environments;
- Implement measures to promote emergency responder safety and general safety of incident operations;
- Provide coordination of multi-agency safety efforts;
- Maintain awareness of active and developing situations and ensures the preparation and implementation of the incident response Safety Plan;
- Conduct safety briefs as necessary; and
- Stop and/or prevent unsafe acts during incident operations.

Primary: Operational Lummi Nation staff familiar with site-specific risks

Alternate: Personnel from responding outside agencies

Applicable Checklist: Safety Officer Checklist as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide



PUBLIC INFORMATION OFFICER (PIO)

The Public Information Officer serves two critical functions at the scene of an emergency: (1) to coordinate and control the interface with the media, the public and other agencies with incident-related information requirements and (2) to activate or represent the Lummi Nation in a Joint Information Center (JIC) when activated.

Public Information Officer Tasks and Responsibilities:

- Ensure that only authorized information is released;
- Organize, assign tasks and supervise all personnel mobilized to support on-scene public information functions;
- Identify staffing needs for support of public information functions and direct mobilization or demobilization of personnel;
- Develop accurate and complete information on the incident's cause, size, current situation, resources committed and other matters of general interest for both internal and external consumption;
- Monitor public information coverage of the situation;
- Managing Social Media and Communication;
- Activate or represent the Lummi Nation in a Joint Information Center as needed;
- Supervise the preparation for and conduct on-scene media briefing(s); and
- Supervise VIP tours of the incident site including providing for controlled/guided escorts.

A Joint Information Center (JIC) is a location where public information specialists and volunteers from local, state, tribal, federal jurisdictions, NGOs and/or private companies meet to coordinate the dissemination of emergency public information. The goal of the JIC is to provide accurate, timely, and coordinated information during an emergency to the media and the public. Some of the services provided are:

- News briefings and conferences to keep the media abreast of new developments.
- Background data to help news media.
- Spokespersons to elaborate on and explain the event.
- An information center the public can contact regarding the emergency.

Primary: Chairman or Designee

Alternate: Not Identified

Applicable Checklists: Public Information Officer Checklist as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide



LEGAL OFFICER (LO)

The appointment of a Legal Officer is not typical, however, in complex or extended incidents or in events that may have civil or criminal complications the addition of legal counsel to the command staff can be very useful. The LO may be assigned to advise Command on legal matters, such as emergency proclamations, the legality of evacuation orders, and legal rights and restrictions pertaining to media access.

Legal Officer Responsibilities:

- Advise Command on related matters;
- Interpret laws and regulations as they pertain to achieving incident objectives;
- Ensure the protection of incident records and documents that may be needed for future legal actions; and
- Represent the Lummi Nation on all outside legal matters

Primary: Reservation Attorney or Designee

Alternate: Not Identified

Applicable Checklists: None as of date



GENERAL STAFF

The General Staff represents and is responsible for the functional aspects of the incident command structure. When fully activated the General Staff typically consists of the Operations, Planning, Logistics and Finance/Administration Sections. The General Staff positions may be activated as needed for Lummi Nation disruptive events or to be assigned to multi-agency Unified Command structures.

OPERATIONS SECTION

The Operations Section is responsible for the management of all operations directly applicable to the primary mission. The Operations Section, led by the Operations Section Chief, activates and supervises organization elements in accordance with the Incident Action Plan (IAP) and directs its execution. This Section also directs the preparation of Unit operational plans, requests or releases resources, makes expedient changes to the IAP, as necessary, and reports such to Incident Command / Unified Command. A typical Operations Section organizational structure is shown in Figure 3.

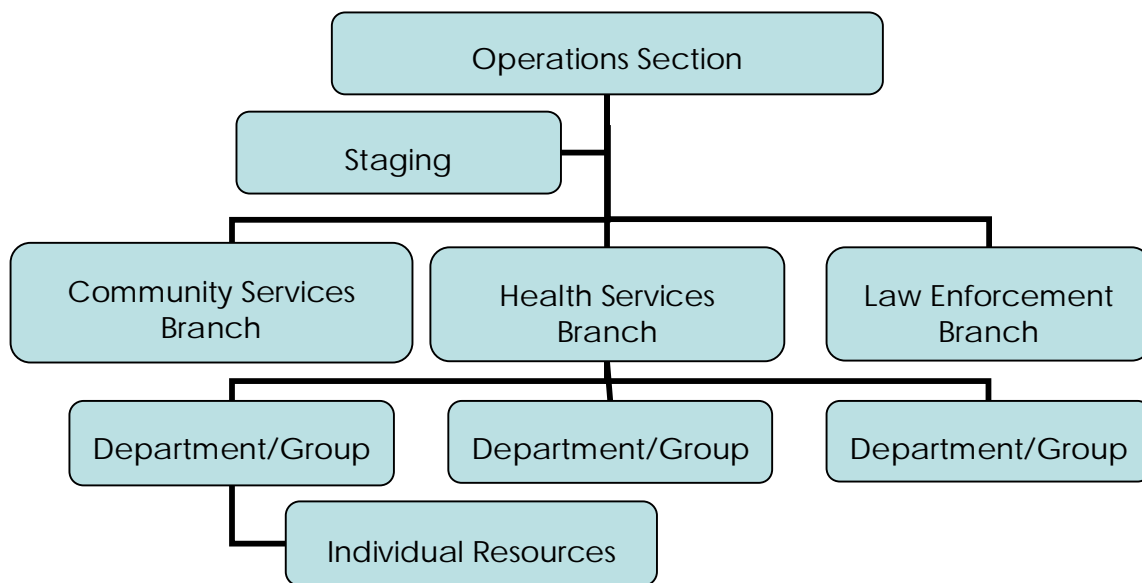


Figure 3 - ICS Operations Section

Operations Section Responsibilities:

- Manage all incident-related operational activities;
- Develop and implement appropriate tactical strategies to meet operational objectives and priorities;
- Establish an appropriate level of staffing and continuously monitor the effectiveness of the organization and modify as required;
- Ensure section objectives as stated in the IAP are accomplished;
- Keep Command informed of all significant issues relating to the section;



- Facilitate communications between on-scene Operations and the Lummi Nation Emergency Coordination Center when activated;
- Interface with the Planning and Logistics Sections, and
- Within a Unified Command, represent the Lummi Nation in Operations Section discussions, decisions and actions;

Community Services Responsibilities:

- Manages and reports to appropriate funding sources food sources from USDA FDPIR, Food Bank and Emergency Food Program.
- Manages and reports to appropriate funding sources use of energy resources from LIHEAP, Lummi Hard Dollars, Wood Program, and CITGO for clients in needs of urgent assistance.
- Maintains records of food purchases made during times of urgent need.
- Sets up and staffs the food preparation and distribution site for emergency workers and clients in need.
- Prepare vehicles belonging to Community Services to provide transportation to locations to feed, house, or assist clients during inclement weather.
- Working with Natural Resource GIS staff to develop and update vulnerable population mapping for servicing community.

Primary:

For site-specific incidents the General Manager or Director of the impacted Facility or Department;

For Lummi Nation wide incidents: Lummi Nation Police Chief or designee

Alternate:

For site-specific incidents - the Manager or Administrator of the impacted Facility or Department;

For Lummi Nation wide incidents: Lummi Nation Police Chief or designee

Applicable Checklists: Operation Section Checklists as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide

PLANNING SECTION

The Planning Section is responsible for the collection, evaluation, and dissemination of tactical information pertaining to an incident. This section maintains information and intelligence on the current and predicted situation, as well as the status of logistics assigned to the incident. The Planning Section prepares and documents the IAP, incident maps and gathers and disseminates information and critical intelligence. The Planning Section also maintains all records associated with the incident. The organizational structure of a fully implemented Planning Section is shown below in Figure 4:

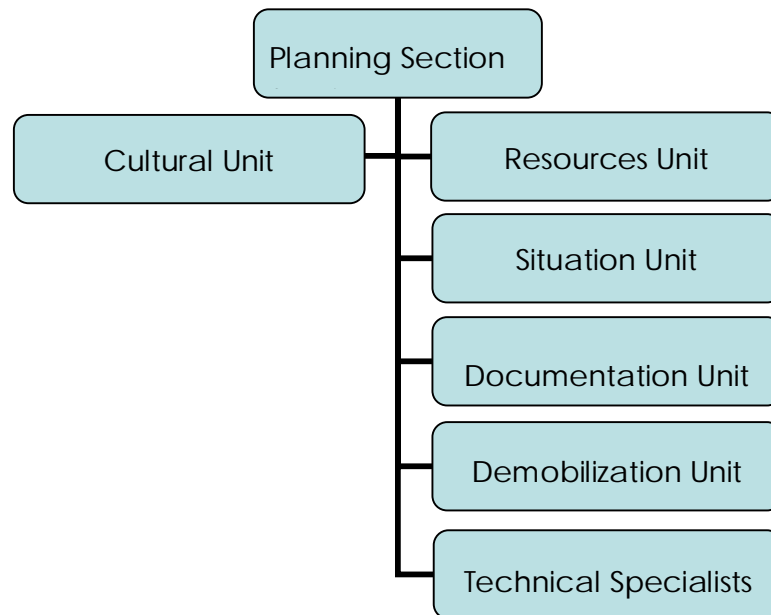


Figure 4 - ICS Planning Section

Planning Section Responsibilities:

- Collect, analyze and display situation information;
- Prepare periodic Situation Reports;
- Prepare and distribute the Incident Action Plan;
- Evaluate the impact on Cultural sites and traditional cultural properties;
- Facilitate planning meetings;
- Plan for incident demobilization;
- Document and maintain incident files;
- Establish an appropriate level of staffing and continuously monitor the effectiveness of the organization and modify as required;
- Ensure section objectives as stated in the IAP are accomplished; and
- Keep Command informed of all significant issues relating to the section.

Primary: Planning

Alternate: Not Identified

Applicable Checklist: Planning Section Checklists as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide

LOGISTICS SECTION

The Logistics Section is tasked with meeting incident support needs, including ordering resources through appropriate procurement authorities from off-incident locations. It also provides facilities, transportation, supplies, equipment maintenance and fueling, food service, lodging, communications, and medical services for incident personnel. The organizational structure of a fully implemented Logistics Section is shown below in Figure 5:

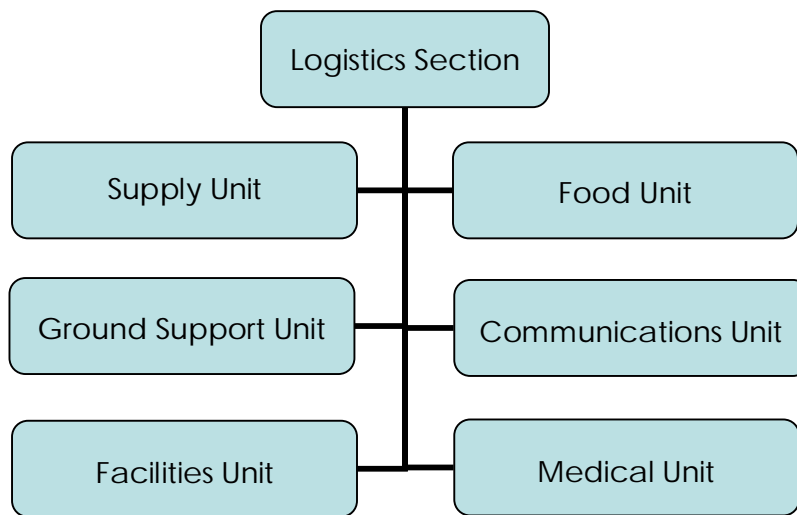


Figure 5 - ICS Logistics Section

Logistics Section Responsibilities:

- Ensure that incident logistical requirements are met. This includes providing communications, resource tracking, and the acquisition of equipment, supplies, personnel, facilities and transportation services;
- Arrange for food, lodging and other support services as required;
- Establish an appropriate level of staffing and continuously monitor the effectiveness of the organization and modify as required;
- Ensure section objectives as stated in the IAP are accomplished;
- Closely coordinate with the Operation Section Chief to establish priorities for resource allocations; and
- Keep Command informed of all significant issues relating to the section.

Primary: Maintenance Supervisor or OMB Staff

Alternate: Community Services

Applicable Checklists: Logistics Section Checklists as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide

FINANCE/ADMINISTRATION SECTION

The Finance Section is responsible for addressing specific needs for financial, reimbursement and/or administrative services to support incident management activities. Not every incident will require a Finance Section. Such a single position can best be placed under planning as a technical specialist. In large, complex or extended incidents a Finance Section is an essential part of the organization. The organizational structure of a fully implemented Finance Section is shown below in Figure 6:

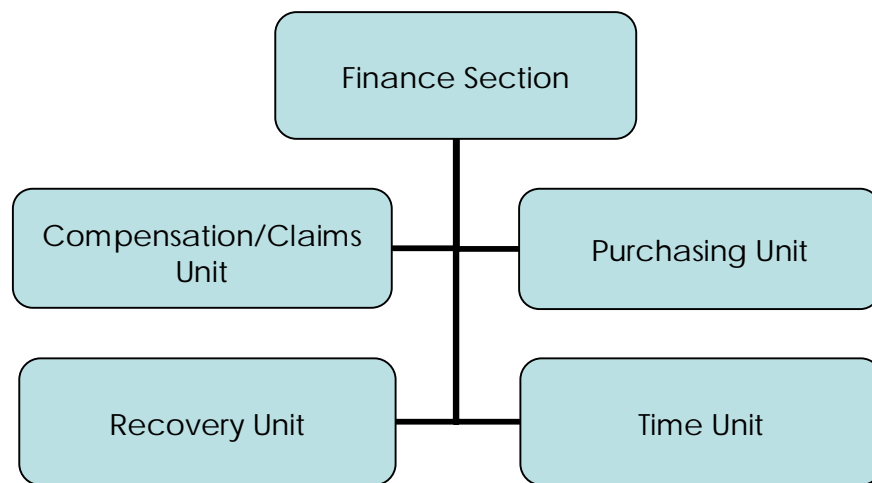


Figure 6 - ICS Finance Section

Finance Section Responsibilities:

- Ensure financial records are maintained throughout the event;
- Ensure all on-duty time is recorded for all response personnel;
- Ensure all on-duty time sheets are collected from supervisors;
- Ensure there is a continuum of the payroll process for all employees;
- Ensure all contracts are consistent with federal and state requirements and Lummi Nation procurement policies;
- Process all travel and expense claims within a reasonable time;
- Provide administrative support to all sections as required;
- Ensure recovery documentation is accurately maintained during the response and ensure the information is submitted on appropriate forms for reimbursement from insurance or FEMA Public Damage Assistance;
- Establish an appropriate level of staffing and continuously monitor the effectiveness of the organization and modify as required;
- Ensure section objectives as stated in the IAP are accomplished; and
- Keep Command informed of all significant issues relating to the section.

Primary: Chief Financial Officer or Designee

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Alternate: Treasurer

Applicable Checklists: Finance Section Checklists as contained in the National Incident Management System Incident Command System Emergency Responder Field Operations Guide



RESPONSIBILITIES

ASSIGNMENT OF GENERAL RESPONSIBILITIES

1. This section covers general emergency responsibilities of the Lummi Nation departments. Additional "department specific" responsibilities follow the general responsibilities.
2. It is the policy of the Lummi Nation that each department is responsible for the following:
 1. Ensuring the safety and protection of the Lummi Nation Community (life/safety).
 2. Securing buildings and facilities where the disruptive event occurred.
 3. Providing for the continuation of essential departmental services and functions after a disaster.
 4. Providing for the identification and preservation of essential department records.
 5. Ensuring appropriate notifications are made in accordance with this plan.
 6. Providing damage assessments and situation reports.
 7. Appointing a liaison to work with Emergency Management in the development and maintenance of this plan.
 8. Establishing 24-hour departmental contacts.
 9. Developing the capability to continue operations in an emergency/disaster and to carry out the responsibilities outlined herein.
 10. Developing procedures that address the following:
 - a. The department's chain of command
 - b. Location of the departmental emergency coordination center and alternate locations including equipment and supplies
 - c. The resources needed to manage departmental emergency operations
 - d. The information needed to manage departmental emergency activities and how it will be obtained
 - e. Departmental capabilities and responsibilities
 - f. Departmental resources
 - g. How the department will coordinate with the Emergency Coordination Center
 - h. Ensuring that department staff is aware of the contents of this plan.
3. It is the policy of the Lummi Nation that departments make staff available for appropriate training and emergency assignments, such as Emergency



Coordination Center (ECC) activities, documentation, damage assessment, and liaison with other agencies and organizations. All costs for these activities shall be the responsibility of the respective department.

ASSIGNMENT OF DEPARTMENT SPECIFIC RESPONSIBILITIES

LUMMI NATION TRIBAL COUNCIL – POLICY

1. Exercise the powers provided to the Tribal Council by the Lummi Nation Constitution.
2. Develop strategic goals, objectives and policies.
3. Ensure that sufficient administrative powers and duties have been delegated to the Chairman to allow an effective operational response to disruptive events.
4. Evaluate and ratify the Chairman's findings of emergencies.
5. Ensure the filling of Tribal Council vacancies that may occur.

LEGAL COUNSEL - LIAISON

1. Respond on-scene or to the Emergency Coordination Center upon request of the Incident Commander.
2. Obtain briefings and situation reports and provide legal counsel as needed.

CHAIRMAN

1. Exercise the delegation of administrative powers and duties as provided by the Tribal Council and the Lummi Nation Constitution.
2. Assume or delegate the position of Incident Commander to ensure effective management of incidents involving the Lummi Nation.
3. Establish spending authorities and delegate administrative authorities to Lummi Nation personnel.
4. Make and issue orders that shall have management authority on matters reasonably related to the protection of life and property as affected by disruptive events.
5. Make findings of an emergency as needed and take or authorize the taking of immediate actions to address emergency situations.
6. Ensure the Tribal Council is kept informed of the situation and the actions being taken to address the situation.
7. Seek Tribal Council ratification of emergency findings as prescribed in the delegation of authority resolution.
8. Activate this plan and the Emergency Coordination Center as needed.
9. Maintain a written log of all actions taken to address the emergency.
10. Seek local Proclamations of Emergency as may be needed to implement extraordinary spending authorities or to obtain state or federal assistance.
11. Participate in "After Action Reviews" and support identified corrective actions.



CHAIRMAN/DIRECTOR OF PUBLIC INFORMATION

1. Maintain up-to-date contact information for local and regional media outlets.
2. Assume the position of Public Information Officer (PIO) for all incidents.
3. Establish or participate in a Joint Information Center (JIC) as needed.
4. Obtain briefings on all emergencies.
5. Monitor media for accuracy and for any new information.
6. Establish rumor controls as needed.
7. Develop news releases for approval by the Superintendent or Incident Commander.
8. Manage Social Media.
9. Participate in PIO/JIC training.
10. Update the Lummi Nation website as needed.

DIRECTOR, LUMMI COMMUNITY SERVICES

1. Manages and reports to appropriate funding sources food sources from USDA FDPIR, Food Bank and Emergency Food Program.
2. Manages and reports to appropriate funding sources use of energy resources from LIHEAP, Lummi Hard Dollars, Wood Program, and CITGO for clients in needs of urgent assistance.
3. Maintains records of food purchases made during times of urgent need.
4. Sets up and staffs the food preparation and distribution site for emergency workers and clients in need.
5. Prepare vehicles belonging to Community Services to provide transportation to locations to feed, house, or assist clients during inclement weather.
6. Working with Natural Resource GIS staff to develop and update vulnerable population mapping for servicing community.

DIRECTOR OF FACILITIES AND MAINTENANCE - LOGISTICS

1. Leads the Logistics Section, Facilities Unit.
2. Arrange for suitable facilities to meet incident requirements.
3. Facilitates the setting up and taking down of facilities as needed.
4. Assists in the setting up of the Emergency Coordination Center and Alternate Coordination Center as needed.
5. Assists community response and recovery by lending available assets as directed by the Chairman or Incident Commander.

DIRECTOR FOR HUMAN RESOURCES – HUMAN RESOURCES

1. Ensure up-to-date personnel files for all staff members.
2. Maintain off site employee/emergency contact roster.
3. Establish/maintain systems for continued benefit(s) enrollment/cancelation.
4. As needed, provide liaison with all personnel and their families.
5. Participate in the Logistics Section Supply Unit to provide and coordinate incident staffing.
6. Maintain up-to-date lists of employment agencies.



7. Support HR staff who are processing worker compensation claims.

LUMMI NATION POLICE DEPARTMENT – PLAN DEVELOPMENT

1. Develop and maintain the Lummi Nation's Risk, Safety, Security, Emergency and Crisis Management Plan.
2. Is responsible for staff training and exercise of the plan.
3. Act as the Lummi Nation's primary liaison with outside emergency management agencies.
4. As needed, develops and maintains hazard specific contingency plans and site-specific security plans.
5. Employ pre-disruptive event mitigation strategies to prevent or minimize disaster impacts to tenant and Lummi Nation properties.
6. Responsible for maintaining compliance with the National Incident Management System.
7. Responsible for maintaining a key accountability management program.
8. Activate this plan and the Emergency Coordination Center as needed
9. May serve in a variety of ICS positions.
10. Conduct "After-Action Reviews" to capture lessons learned and needed improvements following significant incidents.
11. Following Lummi Nation rules and guidelines, establish and coordinate regular agency safety meetings.

DIRECTOR, LUMMI NATION ACCOUNTING

1. Maintain all financial records and produce and maintain budget documents, financial reports.
2. Provide adequate internal controls to ensure financial accountability.
3. Assume or delegate the position of Finance Section Chief as needed.
4. Supervise Accounting and Risk Administration.
5. Account for all employee incident time.
6. Provide a continuum of the payroll process for all employees, including the ability to pay via physical check.
7. Function as the Lummi Nation's Applicant Agent in seeking post-disaster federal public assistance for eligible response and recovery expenses.

INFORMATION SYSTEMS MANAGER

1. Oversee the Lummi Nation's computer, fiber optic and telecommunication networks.
2. Provide vital record protection for all digital information.
3. Provide technical assistance to activate the Emergency Coordination Center.
4. Is assigned to the Communications Unit within the Logistics Section.
5. Develop the incident Communications Plan.
6. Is the Lummi Nation's Point-of-Contact for the Government Emergency Telecommunications System and Wireless Priority Service.



ACCOUNTING – RISK MANAGEMENT

1. Manage the Lummi Nation's insurance program.
2. Receive Incident reports and monitors incidents for possible claims.
3. Processe claims when they occur.
4. Is assigned to the Finance Section to process claims and seek reimbursement for eligible expenses.

SITE DIRECTORS AND MANAGERS

1. Act as a Liaison Officer(s) to interface with outside agencies and jurisdictions.
2. May be assigned as a liaison to represent the Lummi Nation in activated city or county EOCs.
3. Develop or provide assistance in the development of grant applications as needed.
4. Employ pre-disaster mitigation strategies to prevent or minimize disaster impacts to tenant and Lummi Nation properties.
5. Coordinate classroom interruption resources.

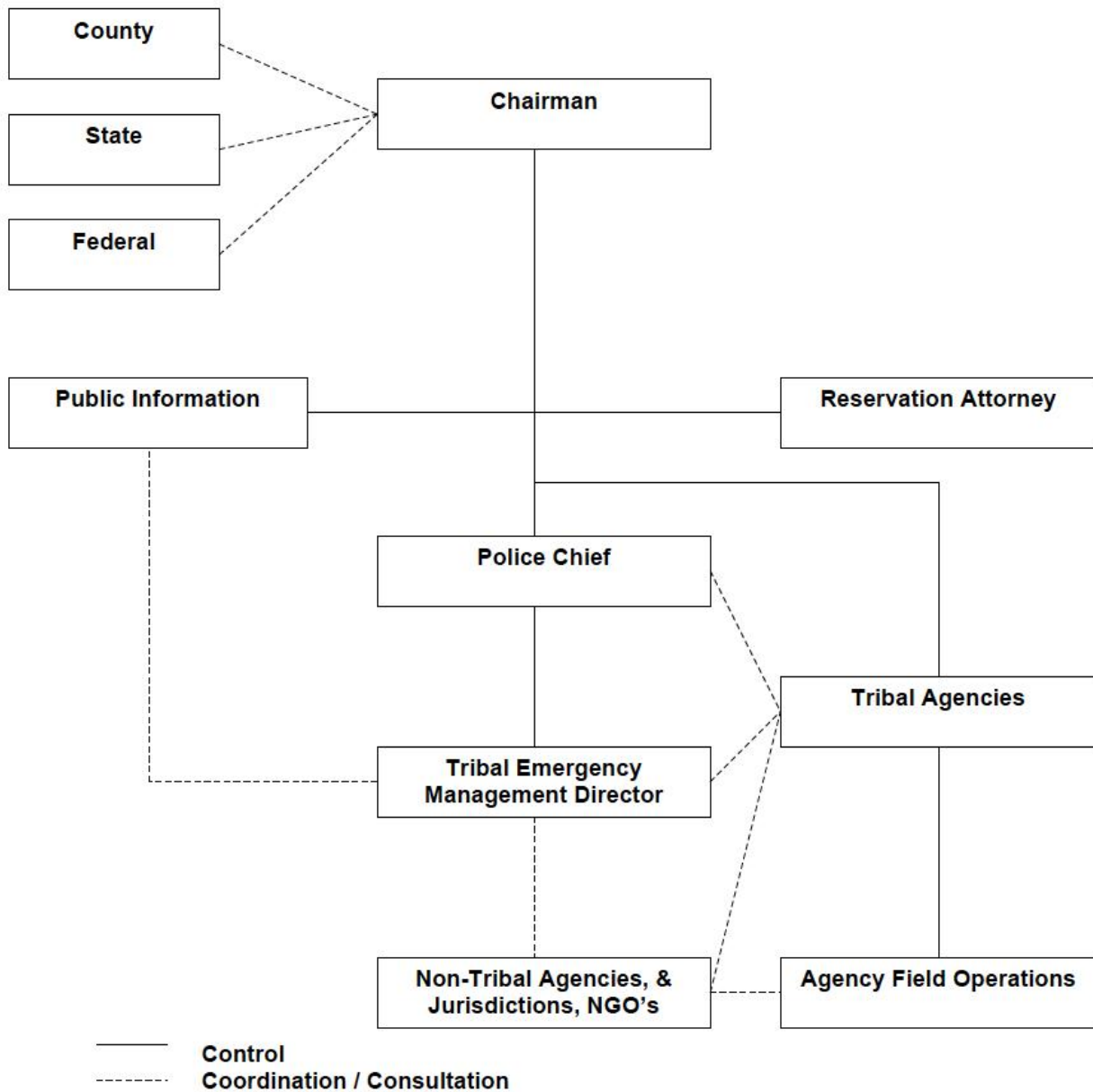
DIRECTOR OF PLANNING – STRUCTURAL MITIGATION/DAMAGE

1. Provide pre-disaster structural mitigation expertise.
2. May be assigned to either the Operations Section for direct operational response or the Planning Section as Technical Specialist.
3. Serve as the Lummi Nation's Structural Evaluation Team (SET) to assess the safety of Lummi Nation facilities and infrastructure following significant events.
4. Make recommendations on occupancy based upon an evaluation of structural integrity.
5. Provide damages assessments as needed.
6. Provide floor plans, drawings, maps and aerial photographs as needed.
7. Working with project sponsors and outside contractors as needed, analyzes damages and designs, permits and constructs capital improvements and major repairs.
8. Develop project cost estimates as needed for assistance or insurance claims. Oversees site cleanup, regulatory compliance and environmental stewardship within the Lummi Nation's jurisdictional authority.
9. May be assigned to either the Operations Section for direct operational response or the Planning Section as Technical Specialist.
10. Conducts post-disaster assessments to ensure containment of hazardous substances.
11. Is assigned to the Logistics and/or Operations Sections as needed.
12. Provides damage assessments as needed.
13. Performs emergency and planned repairs.
14. Provides ground transportation support.

APPENDIX 1 – LUMMI NATION ORGANIZATIONAL CHART

Insert Current
Organizational
Chart

APPENDIX 2 – LUMMI NATION ICS ORGANIZATION



APPENDIX 3 – EMERGENCY NUMBERS

Name	Direct	Emergency
Lummi Nation Police Department	(360) 312-2274	911
Whatcom County Division of Emergency Management (DEM)	(360) 676-6681	911
Whatcom County Fire District #7	(360) 384-0303	911
Whatcom County Fire District #8 / Medic One	(360) 778-8400	911
Whatcom County Fire District #17	(360) 384-1480	911
Whatcom County Health Department	(360) 676-6724	After Hours (360) 715-2588
Whatcom County Medical Examiner	(360) 738-4557	
Whatcom County Sheriff's Office (WCSO)	(360) 676-6650	911
Whatcom Unified Emergency Management (OEM)	(360) 778-8440	Same

APPENDIX 4 – ACCOUNTABILITY GUIDELINES

Note – This is included as reference and should be copied and tailored for each Location to include staff and students as appropriate.

Staff Accountability Checklist							
<input type="checkbox"/>	Last Name	First Name	Office Phone	Cell Phone	Department	Office Location	Notes

Instructions

Staff Accountability Checklist

- 1) After assembling at the primary or secondary assembly point, use the checklist to systematically perform a roll call of everyone at the assembly point.
- 2) For everyone who answers the roll call, place a checkmark (✓) in the left hand column next to his or her name.
- 3) Check with supervisors for known explanations as to the whereabouts of individuals who did not answer the roll call, such as vacation, illness, is out of the building on other business, etc. Use the notes section of the checklist to record the explanation.
- 4) If there are still unaccounted for individuals, check with their co-workers for any viable explanations as to their whereabouts.
- 5) If there are still individuals who have not been accounted for or there are doubts about the whereabouts of any individual, attempt to call their cell phone (if listed) to determine their well-being.
- 6) If you cannot account for everyone on the list, report the missing person(s) to emergency responders.

APPENDIX 5 – SUSPICIOUS PERSON GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

General Guidelines For Identifying Suspicious Persons

- Wearing oversized or inappropriate attire that may conceal a hidden object (e.g. wearing a long heavy coat in warm weather).
- Entering premises without prior notification or on the pretext of being engaged to perform some form of work within the facility or building.
- Loitering near facility or building for an extended period of time.
- Wandering within the facility or building without a valid pass authorizing entry.
- Asking specific questions concerning the security of the premises (e.g. the number of security guards deployed at the premises and the type of security hardware installed at the premises).
- Asking questions about the personal movement of a specific staff or students (e.g. arrival & departure times).
- Not able to provide a reasonable explanation or are uncooperative when asked for their purpose of visit.
- Making an unexpected delivery of a package to an office or to a specific person.
- Placing an object or a parcel within or outside facility or building and departing from the area.

APPENDIX 6 - ASSAULT INCIDENT GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

General Guidelines For Dealing With an Assault

- The incident should be immediately reported to the Lummi Nation Police Department.
- The details of the incident should be recorded in an Incident Book.
- Situations in which persons have been intimidated or threatened with physical violence should also be recorded.
- Where necessary, immediate medical assistance should be sought.
- The Tribal Council may be notified of the incident and, where necessary, an emergency meeting of the Tribal Council should take place.
- The Tribal Council may notify its legal advisors of the assault. The Tribal Council's insurance company should also be notified.
- Where the assault is by a Lummi Nation Member the matter should be dealt with in accordance with Lummi Nation Code of Law.

APPENDIX 7 – LOSS OF BUILDING INFRASTRUCTURE GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

In the event of the loss of any of the infrastructure of a building, including the loss of electricity, water, natural gas, or the failure of the heating, ventilation, air conditioning or cooling (HVAC) the following are guidelines that should be considered:

- Report the outage to your manager or supervisor.
- If the electricity is out, unplug computers or other sensitive electronic equipment until the power is restored.
- Determine, as soon as possible, when the utilities that are out may be restored.
- Coordinate with your manager or supervisor to determine what actions may be taken in the event the outage may be longer term.
- In classrooms, labs or workshops that use natural gas turn off the gas to devices that are accessible in the rooms.
- Ensure that there is an understanding that actions are being taken to understand the situation and that decisions will be made shortly.
- If it is winter and heat has been lost, consider having affected persons put on a jacket or hat to preserve warmth.
- If the water is out, consider alternative plans for bathroom needs.

APPENDIX 8 – CHILD INCIDENT GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

Child incidents do happen in schools and anywhere kids play, are enrolled in or are active. When an incident happens, the actions taken are based on what has occurred. The best way to guard against a child incident is to take mitigation measures that might include:

- Provide paths through hallways, stairways, kitchens, gymnasiums, and locker rooms that are uncluttered and of adequate size to support the number of students and staff members using each space.
- Ensure flooring surfaces are slip-resistant.
- Confirm that stairways have sturdy guardrails.
- Ensure that poisons and chemical hazards in custodial areas, chemistry laboratories, arts classrooms, and vocational education classrooms are labeled and stored in locked cabinets. Students and faculty are instructed regarding the proper use of these chemicals.
- Verify that shop and vocational education equipment is maintained and functioning properly, and safety equipment is in its proper place.
- Inspect that first aid equipment is available throughout the facility or building as well as notices describing procedures to be followed in the event of an injury.
- Be aware of areas that are not readily observable by school staff members, both inside and outside school buildings are regularly monitored by staff members or adult volunteers.
- Verify that sufficient lighting is installed in dark or dimly lit areas.

APPENDIX 9 – ACTIVE SHOOTER GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

Prepare – Be aware that an active shooter scenario could happen and be ready for it by training, exercising and discussing what can be done with law enforcement and first responders.

Run - The first instinct may be to freeze and hide, but if possible, you should get yourself and others out. If there's a special needs student or someone else who may be disoriented, grab him or her if possible.

If You Are Outside When A Shooting Occurs - Drop to the ground immediately, face down as flat as possible. If you are within 15-20 feet of a safe place or cover, duck and run to it. Otherwise, move or crawl away from gunfire, trying to utilize any obstructions between you and the gunfire. Remember that many objects of cover may conceal you from sight, but may not be bulletproof. When you reach a place of relative safety, stay down and do not move. Do not peek or raise your head in an effort to see what may be happening. Wait and listen for directions from Public Safety and/law enforcement personnel.

Leave The Personal Items– The last thing you want to worry about are the items you entered the building with. You want to get out of the building.

If You Can't Run, Hide - do all you can to prevent the shooter from entering the room and causing injury. Lock the door and use a doorstop if there is one. Put a chair, a sofa, and even a desk in front of the door. Turn the lights off. The more weight and objects, the greater the distraction to the shooter trying to get in. This not only makes it harder for him to shoot at you, it lets time be your ally. Stay on the floor, away from doors or windows, and do not peek out to see what may be happening. Make a plan with others in the room about what you will do if the shooter enters. Make a total commitment to action and act as a team with others. If possible and safe to do so, report the location of the assailant.

Silence Your Cellphone - When you get everything set up in the room, if you have not already done so, silence your cellphone and using a landline call 9-1-1 and, whispering, let them know what floor you're on and what you're seeing and hearing. If you're calling from a landline, and something happens and you drop the phone, the address is going to be displayed in the dispatch center. That is not necessarily true for a cellphone.

Fight – If it comes to no other choice, and then fight for your life and those around you. Scissors, hot coffee, the coffee carafe, other glass objects from an office pantry, for example are potential weapons. Fire extinguishers, either engaged or as a weapon to inflict blunt force trauma, are good.

Whatever You Do, Do Something - The first five seconds of an active shooter incident are critical. Don't freeze in disbelief, react immediately.

APPENDIX 10 – EARTHQUAKE GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

- When the earthquake starts duck and cover.
- When the shaking stops, look around to make sure it is safe to move. Then exit the building.
- Help injured or trapped persons. Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. Call for help.
- Look for and extinguish small fires. Fire is the most common hazard after an earthquake.
- Inspect utilities.
- Check for gas leaks. If you smell gas or hear blowing or hissing noise, open a window and quickly leave the building. If possible, turn off the gas at the outside main valve. Do not turn the gas back on.
- Look for electrical system damage. If you see sparks or broken or frayed wires, or if you smell hot insulation, quickly leave the building. If possible, turn off the electricity at the main fuse box or circuit breaker. Do not step in water to turn off electricity. Do not turn electricity back on.
- Check for sewage and water line damage. If you suspect sewage line(s) are damaged, avoid using the toilets. If water pipes are damaged, do not use water from the tap.
- Expect aftershocks. These secondary shockwaves are usually less violent than the main quake but can be strong enough to do additional damage to weakened structures and can occur in the first hours, days, weeks, or even months after the quake.
- Listen to a battery-operated radio or television for the latest emergency information.
- Use the telephone only for emergency calls.
- Stay away from damaged areas unless police, fire, or rescue organizations have specifically requested your assistance.
- After it is determined that its safe to return, your safety should be your primary priority as you begin clean up and recovery.

APPENDIX 11 – FIRE/FIRE ALARM GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

- Unless faced with immediately life threatening circumstances, quickly lock up any cash, gather personal belongings (keys, purses, coats) and evacuate the building, escorting any guests or visitors. Walk; do not run, to the nearest exit.
- Fire extinguishers are located throughout all facilities. Employees are neither obligated nor expected to use the extinguishers in an effort to suppress a fire if such actions exceed the employee's level of training.
- Do not use the elevator.
- Give assistance to anyone having difficulty using the stairs. If necessary, carry disabled people to safety. Request assistance if you have mobility impairment. In the event no one renders help, go to the nearest stairway landing, shout for help and wait there until help arrives.
- Close, but do not lock, doors as you leave. The last person leaving a room or floor should do a final check to make sure no one is left behind.
- Do not allow anyone except emergency responders back into the building.
- Once clear of the building, proceed to the primary assembly point identified for your building. If the primary assembly point is unsafe, please go to the secondary site identified for your building.
- Do not interfere with responding emergency personnel except to assist in their gaining entry into the building or to answer any questions they may have.
- Participate in efforts to account for all who were known to be in the building and follow any further instructions.
- Do not return to the building until permitted by fire officials.
- Do not leave the area until released by your supervisor.

APPENDIX 12 – FLOODING GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

- Listen to local radio and television stations for possible flood warnings and reports of flooding in progress or other critical information such as local road closures.
- Be prepared to evacuate at a moment's notice.
- When a flood or flash flood warning is issued for your area, contact your supervisor and determine if operations should be suspended.
- Stay away from floodwaters if you come upon a flowing stream where water is above your ankles, stop, turn around and go another way.
- If you come upon a flooded road while driving, turn around and go another way.
- If you are caught on a flooded road and waters are rising rapidly around you, get out of the car quickly and move to higher ground. Most cars can be swept away by less than two feet of moving water.
- Keep children out of the water.
- Be especially cautious after dark when it is harder to recognize flood danger.

APPENDIX 13 – HAZARDOUS MATERIALS GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

- Upon detection or notification of a spill of any hazardous materials, notify 911.
- If Shelter in Place Procedures are implemented, close off all outside air intakes and curtail all outdoor activities.
- If Evacuation Procedures are implemented, discuss closing facilities or buildings.
- Determine evacuation procedure in conjunction with Incident Commander.
- If evacuation is to an off-site location, notify Public Information Officer.
- All persons evacuated from the facility(ies) or building(s) are accounted for when everyone has reached the assembly area. Missing persons should be reported to emergency personnel.
- Based on advice from responders, curtail or cease operations.
- Notify the Chairman's Office of the Hazmat event.
- Notify the Lummi Nation Police Department.
- With assistance of responders, determine cause and extent of incident.
- If necessary for cleanup, notify the EPA to assist with development of a cleanup plan.
- Incident Commander gives the all clear and normal operations resume.
- Call staff meeting to hold a review of the incident and discuss changes to procedures.

APPENDIX 14 – HOSTAGE TAKING GUIDELINES

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

- Evaluate the situation. Can this person be approached or controlled without the use of force? How many individuals are involved? What kinds of weapons do they have? What is their demeanor? Is negotiation an option?
- Isolate the perpetrator from other innocent bystanders or potential victims.
- Secure the perimeter.
- Evacuate individuals who can be safely removed from the vicinity.
- Remain calm. The more intense the situation, the greater the need for calmness.
- Get help immediately from whatever source is possible.
- Report the incident to law enforcement.
- Negotiate, if possible.
- Avoid heroics. Don't threaten or intimidate. Keep a safe, non-intimidating distance. Keep your hands clearly visible. Avoid abrupt, sporadic movements.
- Look for a place to dive or jump. Be thinking about a potential escape plan for yourself and others.

APPENDIX 15 –PANDEMIC GUIDELINE

1. Remain calm and take all safe and prudent actions to protect lives and ensure safety.
2. Call 911 for an immediate threat to life, safety or property and be prepared to answer other questions asked by the 911 Operator.
3. If a non-immediate threat to life, safety or property, notify the Lummi Police Department.

Pandemic Response Grid	
Outbreak Characteristics/ Trigger Points	Response Strategy or Tactic
Sustained Human-to-Human transmission with seasonal flu-like virulence	Review plan with planning team
	Planning team meetings as needed
	Consider reassignments of personnel as needed to fulfill critical functions
	Consider deploying hand sanitizers and disinfectant wipes
Sustained Human-to-Human transmission with unknown virulence	Engage with local Pandemic Command Structure
	Planning team meetings as needed
	Consider reassignment of personnel as needed to fulfill critical functions
	Consider deploying hand sanitizers and disinfectant wipes
Sustained Human-to-Human transmission with Mortality less than 10%?	Review plan with planning team
	Engage with local Pandemic Command Structure
	Planning team meetings as needed
	Deploy hand sanitizers and disinfectant wipes
	Implement pandemic leave policy
	Implement an employee communication plan
	Consider implementation of "social distancing" practices
Sustained Human-to-Human transmission with Mortality greater than 10%?	Review plan with planning team
	Engage with local Pandemic Command Structure
	Planning team meetings as needed
	Deploy hand sanitizers and disinfectant wipes
	Implement pandemic leave policy
	Implement an employee communication plan
	Implement "social distancing" practices
	Deploy N95 masks
	Provide family support
	Consider policies to assist with business survivability and recovery
	Consider the need for an Lummi Nation declared emergency

APPENDIX D

Flood Damage Prevention Code – Lummi Nation Code of Laws Title 15A (LCL Title 15A)

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TITLE 15A
LUMMI NATION CODE OF LAWS
FLOOD DAMAGE PREVENTION CODE

Enacted: Resolution 97-119 (7/22/05)

Amended: Resolution 2005-125 (09/12/05)

**TITLE 15A
LUMMI NATION CODE OF LAWS
FLOOD DAMAGE PREVENTION CODE**

Table of Contents

Chapter 15A.01 Authorization, Finding of Fact, and Purpose

15A.01.010 Statutory Authorization.....	1
15A.01.020 Finding of Fact.....	1
15A.01.030 Statement of Purpose	1
15A.01.040 Methods of Reducing Flood Losses.....	1

Chapter 15A.02 Definitions

15A.02.010 Appeal	2
15A.02.020 Area of Shallow Flooding	2
15A.02.030 Base Flood.....	2
15A.02.040 Basement.....	2
15A.02.050 Breakaway Wall.....	2
15A.02.060 Coastal High Hazard Area	2
15A.02.070 Critical Facility	2
15A.02.080 Development	2
15A.02.090 Elevated Building.....	2
15A.02.100 Existing Manufactured Home Park or Subdivision	2
15A.02.110 Expansion to an Existing Manufactured Home Park or Subdivision.....	2
15A.02.120 Flood or Flooding.....	3
15A.02.130 Flood Insurance Rate Map (Firm).....	3
15A.02.140 Flood Insurance Study	3
15A.02.150 Floodway.....	3
15A.02.160 Lowest Floor	3
15A.02.170 Manufactured Home	3
15A.02.180 Manufactured Home Park or Subdivision.....	3
15A.02.190 New Construction	3
15A.02.200 New Manufactured Home Park or Subdivision	3
15A.02.210 Recreational Vehicle.....	3
15A.02.220 Special Flood Hazard Area	3
15A.02.230 Start of Construction	4
15A.02.240 Structure	4
15A.02.250 Substantial Damage.....	4
15A.02.260 Substantial Improvement	4
15A.02.270 Variance	4
15A.02.280 Water Dependent.....	4

Chapter 15A.03 General Provisions

15A.03.010 Land to Which this Ordinance Applies.....	4
15A.03.020 Basis for Establishing the Special Flood Hazard Area	4
15A.03.030 Penalties for Non-Compliance	5
15A.03.040 Abrogation and Greater Restrictions.....	5
15A.03.050 Interpretation.....	5
15A.03.060 Warning and Disclaimer of Liability	5

Chapter 15A.04 Establishment of Development Permit

15A.04.010 Development Permit Required.....	5
15A.04.020 Application for Development Permit.....	5
15A.04.030 Designation of the Director of Planning Department	6
15A.04.031 Duties and Responsibilities of the Director	6
15A.04.040 Variance Procedure	7

Chapter 15A.05 Provisions For Flood Hazard Reduction

15A.05.010 General Standards	8
15A.05.050 Specific Standards.....	9
15A.05.060 Floodways	11
15A.05.070 Encroachments	11
15A.05.080 Standards For Shallow Flooding Areas (AO Zones)	11
15A.05.090 Coastal High Hazard Areas.....	12
15A.05.100 Critical Facility	13

**TITLE 15A
LUMMI NATION CODE OF LAWS
FLOOD DAMAGE PREVENTION CODE**

Chapter 15A.01 Authorization, Finding of Fact, and Purpose

15A.01.010 Statutory Authorization

The Lummi Indian Business Council is delegated the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of the citizens of the Lummi Reservation. Therefore, the Lummi Indian Business Council does ordain as follows:

15A.01.020 Finding of Fact

(a) The flood hazard areas of the Lummi Indian Reservation are subject to periodic inundation that may result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, damages to treaty protected resources, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.

(b) These flood losses are caused by the cumulative effect of winter storms and upstream land uses in the Nooksack River basin which increase flood heights and velocities, and when inadequately managed, damage uses in other areas. Uses that are inadequately floodproofed, elevated, or otherwise protected from flood damage also contribute to the flood loss.

15A.01.030 Statement of Purpose

It is the purpose of this ordinance to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed

- (a) to protect human life and health;
- (b) to minimize expenditure of public money and costly flood control projects;
- (c) to minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general

public;

(d) to minimize prolonged business interruptions;

(e) to minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets, and bridges located in the special flood hazard areas;

(f) to minimize damage to treaty protected resources;

(g) to help maintain a stable tax base by providing for the sound use and development of the special flood hazard areas so as to minimize future flood areas;

(h) to ensure that potential buyers are notified that property is in a special flood hazard area; and,

(i) to ensure that those who occupy the special flood hazard areas assume legal and financial responsibility for their actions.

15A.01.040 Methods of Reducing Flood Losses

In order to accomplish its purposes, this ordinance includes methods and provisions for

(a) restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;

(b) requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;

(c) controlling the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;

(d) controlling filling, grading, dredging, and

other development which may increase flood damage; and

(e) preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or may increase flood hazards in other areas.

Chapter 15A.02 Definitions

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

15A.02.010 Appeal

Means a request for a review of the interpretation of any provision of this ordinance or a request for a variance.

15A.02.020 Area of Shallow Flooding

Means a designated AO, or AH Zone on the Flood Insurance Rate Map (FIRM). The base flood depths range from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and, velocity flow may be evident. AO is characterized as sheet flow and AH indicates ponding.

15A.02.030 Base Flood

Means the flood having a one percent chance of being equaled or exceeded in any given year. Also referred to as the "100-year flood." Designation on maps always includes the letters A or V.

15A.02.040 Basement

Means any area of the building having its floor subgrade (below ground level) on all sides.

15A.02.050 Breakaway Wall

Means a wall that is not part of the structural support of the building and is intended through its design and construction to collapse under specific lateral loading forces, without causing damage to the elevated portion of the building or supporting foundation system.

15A.02.060 Coastal High Hazard Area

Means a special flood hazard area extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The area is designated on the FIRM as Zone V1-V30, VE or V.

15A.02.070 Critical Facility

Means a facility for which even a slight chance of flooding might be too great. Critical facilities include, but are not limited to, schools, nursing homes, hospitals police, fire and emergency response installations, and installations which produce, use, or store hazardous materials or hazardous waste.

15A.02.080 Development

Means any man-made change to improved or unimproved real estate, including but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations located within the special flood hazard areas.

15A.02.090 Elevated Building

Means for insurance purposes, a non-basement building which has its lowest elevated floor raised above ground level by foundation walls, shear walls, post, piers, pilings, or columns.

15A.02.100 Existing Manufactured Home Park or Subdivision

Means a manufactured home park subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date of the adopted floodplain management regulations.

15A.02.110 Expansion to an Existing Manufactured Home Park or Subdivision

Means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either

final site grading or the pouring of concrete pads).

15A.02.120 Flood or Flooding

Means a general and temporary condition of partial or complete inundation of normally dry land areas from

(a) the overflow of inland or tidal waters and/or

(b) the unusual and rapid accumulation of runoff of surface waters from any source.

15A.02.130 Flood Insurance Rate Map (Firm)

Means the official map on which the Federal Insurance Administration has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

15A.02.140 Flood Insurance Study

Means the official report provided by the Federal Insurance Administration that includes flood profiles, the Flood Boundary-Floodway Map, and the water surface elevation of the base flood.

15A.02.150 Floodway

Means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

15A.02.160 Lowest Floor

Means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of this ordinance found at Section 15A.05.050(a)(2).

15A.02.170 Manufactured Home

Means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without

a permanent foundation when attached to the required utilities. The term "manufactured home" does not include a "recreational vehicle."

15A.02.180 Manufactured Home Park or Subdivision

Means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

15A.02.190 New Construction

Means structures for which the "start of construction" commenced on or after the effective date of this ordinance.

15A.02.200 New Manufactured Home Park or Subdivision

Means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of adopted floodplain management regulations.

15A.02.210 Recreational Vehicle

Means a vehicle which is

(a) built on a single chassis;

(b) 400 square feet or less when measured at the largest horizontal projection;

(c) designed to be self-propelled or permanently towable by a light duty truck; and

(d) designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

15A.02.220 Special Flood Hazard Area

Means the land in the flood plain within a community subject to a one percent or greater chance of flooding in any given year. Designation on maps always includes the letters A or V.

15A.02.230 Start of Construction

Includes substantial improvement, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation of the property or accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

15A.02.240 Structure

Means a walled and roofed building including a gas or liquid storage tank that is principally above ground.

15A.02.250 Substantial Damage

Means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

15A.02.260 Substantial Improvement

Means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure either

(a) before the improvement or repair is started; or

(b) if the structure has been damaged and is being restored, before the damage occurred.

For the purposes of this definition “substantial improvement” is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure.

The term can exclude:

(c) any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions, or

(d) any alteration of a structure listed on the National Register of Historic Places or a State Inventory of Historic Places.

15A.02.270 Variance

Means a grant of relief from the requirements of this ordinance which permits construction in a manner that would otherwise be prohibited by this ordinance.

15A.02.280 Water Dependent

Means a structure for commerce or industry which cannot exist in any other location and is dependent on the water by reason of the intrinsic nature of its operations.

Chapter 15A.03 General Provisions

15A.03.010 Land to Which this Ordinance Applies

This ordinance shall apply to all special flood hazard areas within the exterior boundary of the Lummi Indian Reservation, including fee and trust land parcels.

15A.03.020 Basis for Establishing the Special Flood Hazard Area

A scientific and engineering report commissioned by the Federal Insurance Administration (FIA) shall identify the special flood hazard areas. When the report is completed, along with accompanying flood insurance rate maps (FIRM), it shall be adopted and incorporated by reference into this ordinance. Future studies and flood insurance maps, as amended, shall become a part of this ordinance. The Flood Insurance

Study (FIS), when completed, shall be on file at the Lummi Nation Planning Department. Until the study is completed, the Lummi Nation Planning Department shall use the best information available, as outlined in Chapter 15A.04.031(b), to determine the special flood hazard areas and required elevations of structures, until a new FIRM is issued which incorporates the data utilized in Chapter 15A.04.031(b).

15A.03.030 Penalties for Non Compliance

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. Violations of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions), shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be fined not more than \$1000.00, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the Lummi Indian Business Council from taking such other lawful action as is necessary to prevent or remedy any violation.

15A.03.040 Abrogation and Greater Restrictions

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and another ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

15A.03.050 Interpretation

In the interpretation and application of this ordinance, all provisions shall be

- (a) considered as minimum requirements;
- (b) liberally construed in favor of the governing body; and
- (c) deemed neither to limit or repeal any other powers granted under Lummi Nations laws

and federal statutes.

15A.03.060 Warning and Disclaimer of Liability

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the special flood hazard areas or uses permitted within such areas will be free from flooding or flood damages. This ordinance shall not create liability on the part of Lummi Indian Business Council, any officer or employee thereof, or the Federal Insurance Administration, for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

Chapter 15A.04 Establishment of Development Permit

15A.04.010 Development Permit Required

A development permit shall be obtained before construction or development begins within any special flood hazard area established in Chapter 15A.03.020. The permit shall be for all structures including manufactured homes, as set forth in the "DEFINITIONS," and for all development including fill and other activities, also as set forth in the "DEFINITIONS."

15A.04.020 Application for Development Permit

Application for a development permit shall be made on forms furnished by the Planning Department and may include but not be limited to plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities, and the location of the foregoing. Specifically, the following information is required:

- (a) Elevation in relation to mean sea level, of the lowest floor (including basement) of all structures;

(b) Elevation in relation to mean sea level to which any structure has been floodproofed;

(c) Certification by a registered professional engineer or architect that the floodproofing methods for any nonresidential structure meet the floodproofing criteria in Chapter 15A.05.050(b); and

(d) Description of the extent to which a watercourse will be altered or relocated as a result of proposed development.

15A.04.030 Designation of the Director of Planning Department

The Director of the Planning Department (Director) is hereby appointed to administer and implement this ordinance by granting or denying development permit applications in accordance with its provisions.

15A.04.031 Duties and Responsibilities of the Director

Duties of the Director shall include, but not be limited to:

(a) Permit Review.

(1) Review all development permits to determine that the permit requirements of this ordinance have been satisfied.

(2) Review all development permits to determine that all necessary permits have been obtained from those Federal, State, or local governmental agencies from which prior approval is required.

(3) Review all development permits to determine if the proposed development is located in the floodway. If located in the floodway, assure that the encroachment provisions of Chapter 15A.05.060(a) are met.

(b) Use of Other Base Flood Data

When base flood elevation data has not been provided in accordance with Chapter 15A.03.020, BASIS FOR ESTABLISHING THE SPECIAL FLOOD HAZARD AREAS, the Director shall obtain, review, and reasonably utilize any base flood elevation

and floodway data available from a Federal, State or other source, in order to administer Chapters 15A.05.050, SPECIFIC STANDARDS, and 15A.05.060 FLOODWAYS.

(c) Information to be Obtained and Maintained.

(1) Where base flood elevation data is provided through the Flood Insurance Study or required as in Section 15A.04.031(b), obtain and record the actual elevation (in relation to mean sea level) of the lowest floor (including basement) of all new or substantially improved structures, and whether or not the structure contains a basement.

(2) For all new or substantially improved floodproofed non-residential structures

(A) verify and record the actual elevation (in relation to mean sea level), and

(B) maintain the floodproofing certifications required in Section 15A.04.020(c).

(c) Maintain for public inspection all records pertaining to the provisions of this ordinance.

(d) Alteration of Watercourses.

(1) Provide the Director plans and application for watercourse alteration prior to any alteration or relocation of a watercourse, and submit evidence of Tribal approval to the Federal Insurance Administration.

(2) Require that maintenance is provided within the altered or relocated portion of said watercourse so that the flood carrying capacity is not diminished and fish and wildlife habitats are protected according to designs and mitigation plans jointly approved by the Director and by the Lummi Natural Resources Department.

(e) Interpretation of FIRM Boundaries.

Make interpretations where needed, as to exact location of the boundaries of the special flood hazard areas (for example, where there

appears to be a conflict between a mapped boundary and actual field conditions). The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation as provided in Section 15A.04.040.

15A.04.040 Appeal and Variance Procedure

(a) Appeal Board.

(1) The Lummi Planning Commission (Commission) as established by the Lummi Indian Business Council shall hear and decide appeals and requests for variances from the requirements of this ordinance.

(2) The Commission shall hear and decide appeals when it is alleged there is an error in any requirement, decision, or determination made by the Planning Department in the enforcement or administration of this ordinance.

(3) Those aggrieved by the decision of the Commission, or any landowner, may appeal such decision to the Lummi Indian Business Council, as provided in the Constitution of the Lummi Nation.

(4) In passing upon such applications, the Commission shall consider all technical evaluations, all relevant factors, standards specified in other sections of this ordinance, and

(A) the danger that materials may be swept onto other lands to the injury of others;

(B) the danger to life and property due to flooding or erosion damage;

(C) the susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;

(D) the importance of the services provided by the proposed facility to the community;

(E) the necessity to the facility of a

waterfront location, where applicable;

(F) the availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;

(G) the compatibility of the proposed use with existing and anticipated development;

(H) the relationship of the proposed use to the comprehensive plan and flood plain management program for that area;

(I) the safety of access to the property in times of flood for ordinary and emergency vehicles;

(J) the expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site;

(K) the costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water systems, and streets and bridges;

(L) the potential adverse impacts to natural resources; and

(M) the potential adverse impacts to treaty protected resources.

(5) Upon consideration of the factors of Section 15A.04.040(a)(4) and the purposes of this ordinance, the Commission may attach such conditions to the granting of variances as it deems necessary to further the purposes of this ordinance.

(6) The Commission shall maintain the records of all appeal actions and report any variances to the Federal Insurance Administration upon request.

(b) Conditions for Variances

(1) Generally, the only condition under which a variance from the elevation

standard may be issued is for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing items (A-M) in Section 15A.04.040(a)(4) have been fully considered. As the lot size increases the technical justification required for issuing the variance increases.

(2) Variances may be issued for the reconstruction, rehabilitation, or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, or declared a historic place by the Lummi Nation, without regard to the procedures set forth in this section.

(3) Variances shall not be issued within a designated floodway if any increase in flood levels during the base flood discharge would result.

(4) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

(5) Variances shall only be issued upon

(A) a showing of good and sufficient cause;

(B) a determination that failure to grant the variance would result in exceptional hardship to the applicant; and

(C) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public as identified in Section 15A.04.040(a)(4), or conflict with existing local laws or ordinances.

(6) Variances as interpreted in the National Flood Insurance Program are based on the general zoning law principle that they pertain to a physical piece of property; they are not personal in nature and do not pertain to the structure, its inhabitants, economic or financial circumstances. They

primarily address small lots in densely populated residential neighborhoods. As such, variances from the flood elevations should be quite rare.

(7) Variances may be issued for nonresidential buildings in very limited circumstances to allow a lesser degree of floodproofing than watertight or dry-floodproofing, where it can be determined that such action will have low damage potential, complies with all other variance criteria except 15A.04.040(b)(1), and otherwise complies with Sections 15A.05.010(a) and 15A.05.010(b) of the GENERAL STANDARDS.

(8) Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

Chapter 15A.05 Provisions For Flood Hazard Reduction

15A.05.010 General Standards

In all special flood hazard areas, the following standards are required:

(a) Anchoring

(1) All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.

(2) All manufactured homes must likewise be anchored to prevent flotation, collapse, or lateral movement, and shall be installed using methods and practices that minimize flood damage. Anchoring methods may include, but are not limited to, use of over-the-top or frame ties to ground anchors (Reference FEMA's "Manufactured Home Installation in Flood Hazard Areas" guidebook for additional techniques).

(b) Construction Materials and Methods

(1) All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.

(2) All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.

(3) Electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities shall be designed and/or otherwise elevated or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

(c) Utilities

(1) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

(2) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters.

(3) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

(d) Subdivision Proposals

(1) All subdivision proposals shall be consistent with the need to minimize flood damage;

(2) All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage;

(3) All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage; and

(4) Where base flood elevation data has not been provided or is not available from another authoritative source, it shall be generated for subdivision proposals and

other proposed developments which contain at least 50 lots or 5 acres (whichever is less).

(e) Review of Building Permits.

Where elevation data is not available either through the Flood Insurance Study or from another authoritative source Section 15A.04.031(b), Applications for building permits shall be reviewed to assure that proposed construction will be reasonably safe from flooding. The test of reasonableness is a local judgment and includes use of historical data, high water marks, photographs of past flooding, etc., where available. Failure to elevate at least two feet above grade in these zones may result in higher insurance rates.

15A.05.050 Specific Standards

In all special flood hazard areas where base flood elevation data has been provided as set forth in Section 15A.03.020, BASIS FOR ESTABLISHING THE SPECIAL FLOOD HAZARD AREAS or Section 15A.04.031, Use of Other Base Flood Data, the following provisions are required:

(a) Residential Construction

(1) New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated one foot above the base flood elevation.

(2) Fully enclosed areas below the lowest floor that are subject to flooding are prohibited, or shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria:

(A) A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall provided.

(B) The bottom of all openings shall be

no higher than one foot above grade.

(C) Openings may be equipped with screens, louvers, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

(b) Nonresidential Construction

New construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest floor, including basement, elevated one foot above the base flood elevation; or, together with attendant utility and sanitary facilities, shall

(1) be floodproofed so that below one foot above the base flood level the structure is watertight with walls substantially impermeable to the passage of water;

(2) have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy;

(3) be certified by a registered professional engineer or architect that the design and methods of construction are in accordance with accepted standards of practice for meeting provisions of this subsection based on their development and/or review of the structural design, specifications and plans. Such certifications shall be provided to the official as set forth in Section 15A.04.031(c)(2);

(4) nonresidential structures that are elevated, not floodproofed, must meet the same standards for space below the lowest floor as described in 15A.05.050(a)(2);

(5) applicants floodproofing nonresidential buildings shall be notified that flood insurance premiums will be based on rates that are one foot below the floodproofed level (e.g., a building floodproofed to the base flood level will be rated as one foot below).

(c) Manufactured Homes.

(1) All manufactured homes to be placed or substantially improved within Zones A1-A30, AH, and AE on the community's

FIRM on sites

(A) outside of a manufactured home park or subdivision,

(B) in a new manufactured home park or subdivision,

(C) in an expansion to an existing manufactured home park or subdivision, or

(D) in an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as the result of a flood; shall be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated one foot above the base flood elevation and be securely anchored to an adequately anchored foundation system to resist flotation collapse and lateral movement.

(2) Manufactured homes to be placed or substantially improved on sites in an existing manufactured home park or subdivision within Zones A1-30, AH, and AE on the community's FIRM that are not subject to the above manufactured home provisions shall be elevated so that either

(A) the lowest floor of the manufactured home is elevated one foot above the base flood elevation, or

(B) the manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than 36 inches in height above grade and be securely anchored to an adequately anchored foundation system to resist flotation, collapse, and lateral movement. At a minimum a "reinforced pier" would have a footing adequate to support the weight of the manufactured home under saturated soil conditions such as occur during a flood. In addition, if stacked concrete blocks are used, vertical steel reinforcing rods should be placed in the hollows of the blocks and those hollows filled with concrete or high strength mortar. In

areas subject to high velocity floodwaters and debris impact, cast-in-place reinforced concrete piers may be appropriate.

(d) **Recreational Vehicles.**

Recreational vehicles placed on sites within Zones A1-30, AH, and AE on the community's FIRM shall

(1) be on the site for fewer than 180 consecutive days and fully licensed and ready for highway use, on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions; or

(2) meet the requirements of 15A.05.050(d) above and the elevation and anchoring requirements for manufactured homes.

15A.05.060 Floodways

Located within the special flood hazard areas established in Section 15A.03.020 are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

(a) Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered professional engineer is provided demonstrating through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.

(b) Construction or reconstruction of residential structures is prohibited within designated floodways, except for

(1) repairs, reconstruction, or improvements to a structure which do not increase the ground floor area; and

(2) repairs, reconstruction or improvements to a structure, the cost of which does not

exceed 50 percent of the market value of the structure either

(A) before the repair or reconstruction is started, or

(B) if the structure has been damaged, and is being restored, before the damage occurred. Work done on structures to comply with existing health, sanitary, or safety codes or to structures identified as historic places shall not be included in the 50 percent.

(c) If Section 15A.05.060(a) is satisfied, all new construction and substantial improvements shall comply with all applicable flood hazard reduction provisions of Section 15A.05, PROVISIONS FOR FLOOD HAZARD REDUCTION.

15A.05.070 Encroachments

In areas with a designated floodway, no new construction, substantial improvements, or other development (including fill) shall be permitted within Zones A1-30 and AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, where combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community.

15A.05.080 Standards For Shallow Flooding Areas (AO Zones)

Shallow flooding areas appear on FIRMs as AO zones with depth designations. The base flood depths in these zones range from 1 to 3 feet above ground where a clearly defined channel does not exist, or where the path of flooding is unpredictable and where velocity flow may be evident. Such flooding is usually characterized as sheet flow. In these areas, the following provisions apply:

(a) New construction and substantial improvements of residential structures and manufactured homes within AO zones shall have the lowest floor (including basement) elevated above the highest grade adjacent to the building, one foot or more above the depth number specified on the FIRM (at least two

feet if no depth number is specified).

(b) New construction and substantial improvements of nonresidential structures within AO zones shall either

(1) have the lowest floor (including basement) elevated above the highest adjacent grade of the building site, one foot or more above the depth number specified on the FIRM (at least two feet if no depth number is specified); or

(2) together with attendant utility and sanitary facilities, be completely flood proofed to or above that level so that any space below that level is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. If this method is used, compliance shall be certified by a registered professional engineer or architect as in section 15A.05.050(b)(3).

(c) Require adequate drainage paths around structures on slopes to guide floodwaters around and away from proposed structures.

(d) Recreational vehicles placed on sites within AO Zones on the community's FIRM shall

(1) be on the site for fewer than 180 consecutive days and be fully licensed and ready for highway use on its wheels or jacking system; be attached to the site only by quick disconnect type utilities and security devices; and have no permanently attached additions; or

(2) meet the requirements of 15A.05.080 above and the elevation and anchoring requirements for manufactured homes.

15A.05.090 Coastal High Hazard Areas

Located within the special flood hazard areas established in Section 15A.03.020 are Coastal High Hazard Areas, designated as Zones V1-V30, VE and/or V. These areas have special flood hazards associated with high velocity

waters from surges and, therefore, in addition to meeting all provisions in this ordinance, the following provisions shall also apply:

(a) All new construction and substantial improvements in Zones V1-V30 and VE (V if base flood elevation data is available) shall be elevated on pilings and columns so that

(1) the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated one foot or more above the base flood level; and

(2) the pile or column foundation and structure attached thereto is anchored to resist flotation, collapse and lateral movement due to the effects of wind and water loads acting simultaneously on all building components. Wind and water loading values shall each have a one percent chance of being equaled or exceeded in any given year (100-year mean recurrence interval).

(b) A registered professional engineer or architect shall develop or review the structural design, specifications and plans for the construction, and shall certify that the design and methods of construction to be used are in accordance with accepted standards of practice for meeting the provisions of (1) and (2) of this Section.

(c) Obtain the elevation (in relation to mean sea level) of the bottom of the lowest structural member of the lowest floor (excluding pilings and columns) of all new and substantially improved structures in Zones V1-30 and VE, and whether or not such structures contain a basement. The local administrator shall maintain a record of all such information.

(d) All new construction shall be located landward of the reach of ordinary high water.

(e) Provide that all new construction and substantial improvements have the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls, open wood lattice-work, or insect screening intended to

collapse under wind and water loads without causing collapse, displacement, or other structural damage to the elevated portion of the building or supporting foundation system. For the purpose of this section, a breakaway wall shall have a design safe loading resistance of not less than 10 and no more than 20 pounds per square foot. Use of breakaway walls which exceed a design safe loading resistance of 20 pounds per square foot (either by design or when so required by local or State codes) may be permitted only if a registered professional engineer or architect certifies that the designs proposed meet the following conditions:

- (1) Breakaway wall collapse shall result from water load less than that which would occur during the base flood; and
- (2) The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects wind and water loads acting simultaneously on all building components (structural and nonstructural). Maximum wind and water loading values to be used in this determination shall each have a one percent chance of being equaled or exceeded in any given year (100-year mean recurrence interval).
- (f) If breakaway walls are utilized, such enclosed space shall be useable solely for parking of vehicles, building access, or storage. Such space shall not be used for human habitation.
- (g) Prohibit the use of fill for structural support of buildings.
- (h) Prohibit man-made alteration of sand dunes which would increase potential flood damage.
- (i) All manufactured homes to be placed or substantially improved within Zones V1-V30, V, and VE on the community's FIRM on sites
 - (1) outside of a manufactured home park or subdivision,

- (2) in a new manufactured home park or

subdivision,

- (3) in an expansion to an existing manufactured home park or subdivision, or

- (4) in an existing manufactured home park or subdivision on which a manufactured home has incurred "substantial damage" as the result of a flood shall meet the standards of paragraphs 15A.05.090(a) through (h) of this section and that manufactured homes placed or substantially improved on other sites in an existing manufactured home park or subdivision within Zones V1-30, V, and VE on the FIRM meet the requirements of Section 15A.05.050(d).

- (j) Recreational vehicles placed on sites within Zones V1-30, V, and VE on the community's FIRM either

- (1) be on the site for fewer than 180 consecutive days and be fully licensed and ready for highway use on its wheels or jacking system; be attached to the site only by quick disconnect type utilities and security devices; and have no permanently attached additions; or

- (2) Meet the requirements of Section 15A.04.010 (Permitting requirements) and paragraphs 15A.05.090(a) through (h) of this section.

15A.05.100 Critical Facility

Construction of new critical facilities shall be, to the extent possible, located outside the limits of the Special Flood Hazard Area (SFHA) (100-year floodplain). Construction of new critical facilities shall be permissible within the SFHA if no feasible alternative site is available. Critical facilities constructed within the SFHA shall have the lowest floor elevated three feet or more above the level of the base flood elevation (100-year) at the site. Floodproofing and sealing measures must be taken to ensure that toxic substances will not be displaced by or released into flood waters. Access routes elevated to or above the level of the base flood elevation shall be provided to all critical facilities to the extent possible.

Title15Apub08

APPENDIX E

Summary of Lummi Nation Flood Policies

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FLOOD MITIGATION POLICIES OF THE LUMMI NATION

Policies recommended to direct the floodplain, coastal, and watershed-management activities of the Lummi Nation are listed in this appendix. Adoption of the Lummi Nation Flood Damage Reduction Plan (FDRP) by the LIBC (Resolution # 2001-131) certifies that these policies have been adopted by the LIBC. These policies provide a set of operating principles to guide flood-hazard-reduction efforts over the long term. The policies are divided into seven categories: general policies; floodplain land use; watershed management; flood-hazard-reduction projects; river-channel maintenance; flood warning, information, and education; and emergency response. These categories and much of the text were incorporated or adapted from the Tillamook County Flood Hazard Mitigation Plan (Tillamook County 1996).

GENERAL POLICIES

The general policies listed below form a mission statement for the FDRP, providing general guidance for all future activities. All other policies and recommendations in this plan are designed to fulfill one or more of these general policies.

National Flood Insurance Program (NFIP) Policy G-1:

In order to better protect public health and safety and to achieve discounts of flood-insurance premiums by qualifying for the CRS Program, the Lummi Nation should not only meet, but also exceed where practicable, the federal minimum standards for NFIP qualification.

Restricting New Development in Hazardous Areas Policy G-2:

New subdivisions, new residential and commercial development, and substantial improvement of commercial and residential structures should be discouraged (if not already prohibited by Title 15A FDPC) on lands identified as a floodway or a coastal velocity zone.

Title 15A Restrictions Must Be Enforced Policy G-3:

Development may be allowed in areas of lesser flood hazard in identified floodplains (i.e., the flood fringe) or in coastal flooding areas only if it can be built to withstand flooding without suffering significant damage. Title 15A restrictions must be enforced.

Reducing Flood Impacts to Existing Developments Policy G-4:

The Lummi Nation should seek to reduce the risk of severe flood hazards and damages experienced by existing public and private developments.

Flood Damage Reduction Plan Policy G-5:

New development or other actions should not be allowed to increase flood risks to existing properties and development.

Reducing Long-Term Public Costs Policy G-6:

Where possible, flood-hazard-reduction projects should be selected, designed, and implemented to be permanent or low-maintenance solutions to flood problems.

Protecting Natural Resources and Functions Policy G-7:

The existing flood storage, conveyance functions, and ecological values of floodplains, wetlands, and riparian corridors should be protected and, where possible, enhanced or restored.

Multi-Objective Management of Water Resources Policy G-8:

Floodplains, rivers, streams, coastal areas, and other water resources should be managed for multiple uses, including flood- and erosion-hazard reduction, fish and wildlife habitat, fish harvesting, agriculture, open space, recreation, and, where appropriate, water supply.

Planning with a Watershed Perspective Policy G-9:

Flood-damage-reduction plans and projects should be developed in a basin-wide context using watershed councils or similar inter-governmental commissions, recognizing that the watershed and drainage network function as an interdependent system.

Intergovernmental Coordination and Cooperation Policy G-10:

The Lummi Nation's floodplain- and watershed-management activities should be planned and implemented in cooperation with cities, counties and other agencies sharing jurisdiction in the Nooksack River basin, consistent with co-management responsibilities of tribes and tribal treaty rights. The Lummi Nation should also closely review the management plans and activities of other jurisdictions.

Assessment of Flood Problems and Mitigation Alternatives Policy G-11:

Solutions to flood problems should be derived from a science-based assessment of flood problems and potential mitigation alternatives.

FLOODPLAIN LAND-USE POLICIES**Future-Conditions Floodplain Policy FP-1:**

Wherever future-condition flows have been modeled and adopted as part of a basin plan, they should be used to define the 100-year flood of record and future-conditions floodplain (i.e., the 100-year floodplain expected under build-out of current land-use plans and regulations for the basin). In the Nooksack River basin and coastal flood areas, land-use policies and flood-hazard regulations should apply to the 100-year future-conditions floodplain.

Development in the FEMA Floodway Policy FP-2:

The current floodway standards, contained in the Lummi Nation Title 15A FDPC, should be maintained and consistently enforced. These standards prohibit new residential structures. New commercial development in a floodway should be avoided unless it is the only practicable alternative.

Development in FEMA Coastal High Hazard Areas (Velocity Zones) Policy FP-3:

The current standards for coastal high hazard areas, contained in the Lummi Nation Title 15A FDPC, should be maintained and consistently enforced. New commercial development should be avoided unless it is the only practicable alternative.

Construction Standards for Flood Protection Policy FP-4:

New development and substantial improvements in the floodplain should be constructed so that they can withstand the 100-year flood without sustaining significant damage. They should be built so that the lowest finished floor is one foot above the projected 100-year flood within the designated 100-year flood fringe. Areas below the lowest finished floor of residential structures should be designed to allow for the entry and exit of floodwaters.

Floodplain Land Uses Policy FP-5:

In areas designated for agriculture or “rural residential” use in the Lummi Nation General Land-Use Plan (GLUP), land uses which preserve the natural flood storage and conveyance functions of the floodplain – such as agriculture, open space, fish and wildlife habitat, and recreation – are preferred within the floodplain.

Policy FP-6:

Critical facilities and land uses that represent special risks (e.g., hazardous waste storage facilities, hospitals, schools, nursing homes, and police and fire stations) should not be built in the floodplain or coastal flood zones unless no reasonable alternative is available. If located in the floodplain, these facilities and the access routes needed for their operation should be built in a manner that protects public health and safety during at least the 100-year flood. In addition, special measures should be taken to ensure that hazardous or toxic substances are not released into floodwaters.

Migrating Rivers Policy FP-7:

Channel-migration hazard areas should be identified through geomorphologic analyses and review of historic channel-migration patterns and rates. Land-use regulations should be adopted and applied in order to preclude unsafe development in these areas.

Reducing Flood Impacts on Agriculture - Cow Pads and Manure Lagoons Policy FP-8:

The construction of elevated cow pads is encouraged as a means to protect livestock on farms that are subject to significant flooding.

Policy FP-9:

If manure lagoons associated with concentrated animal feeding operations are located in the flood plain, they must be flood-proofed

WATERSHED-MANAGEMENT POLICIES**Impacts of Basin-wide Land Uses on Flooding Policy WM-1:**

The Lummi Nation should participate in the development of watershed analysis and comprehensive basin plans for the Nooksack River watershed (as in the Water Resource Inventory Area 1 [WRIA 1] Watershed Management Project) to ensure that the best available science is used to support decisions on natural resource management.

Policy WM-2:

Basin plans should estimate the downstream effects of increased runoff rates and/or volumes caused by clearing and development of upstream lands.

Policy WM-3:

Where downstream impacts will result from increased runoff rates and volumes, new upland land uses should be required to either control runoff rates and volumes or to apply other equally effective measures to protect downstream properties.

FLOOD-HAZARD-REDUCTION PROJECT POLICIES**Flood-Hazard Problems Policy FHR-1:**

The following types of properties and problems are eligible for protection:

- (1) Properties where there is an imminent threat to public health or safety;
- (2) Usual and accustomed (U & A) grounds and stations for which the Lummi Nation has treaty rights to hunt, fish, and gather;
- (3) Cultural resources;
- (4) Lummi Nation capital improvements (e.g., water-treatment plants, wastewater-treatment plants, roads, fish hatcheries, and buildings);
- (5) The Lummi Nation has a written maintenance agreement or other legal obligation to protect the site;
- (6) A Lummi Nation action caused or contributed to the problem;
- (7) Other public property (such as a road, bridge, or park); and
- (8) Private homes, businesses, or agricultural uses vulnerable to severe damage.

Problem Prioritization Policy FHR-2:

In determining the priority of a problem, the following factors should be taken into consideration: consequences, urgency, responsibility, and opportunity. These factors are described below.

Consequences: The primary factor that determines the priority of a problem is the consequences that would result if a project is not implemented. Consequences should generally be prioritized in the following order:

- (1) Threats to public health and safety. Threats to public health and safety include threats to critical facilities (e.g., hospitals, schools, nursing homes, and emergency response facilities) and/or health-related infrastructures (e.g., water supply systems, sewer lines). The presence of deep, high velocity flows carrying debris through populated areas also constitutes a threat to life and limb.
- (2) Damage to public infrastructure and developed public property. Public infrastructure and developed public property includes, but is not limited to, roads, bridges, utility systems, public buildings, and fish hatcheries.
- (3) Damage to private structures. Private residential structures should receive higher priority than non-residential structures.
- (4) Damage to significant natural resources. Significant natural resources include fish and wildlife species and habitats that are considered regionally significant.
- (5) Damage to undeveloped public land. Undeveloped public land refers to both publicly-owned open space and land for which development rights have been purchased, such as agricultural land.

Urgency: Urgency is a measure of how quickly action needs to be taken in order to prevent a problem from growing worse and requiring an increasingly costly solution. For example, the magnitude of an erosion-related problem will generally increase over time if not addressed. In comparing problems where equal consequences would result if action is not taken, the most urgent problem should be addressed first.

Responsibility: Another important factor is whether the problem is related to a facility that the Lummi Nation has a legal commitment to maintain. In comparing problem sites with comparable consequences and urgency, those associated with facilities that the Lummi Nation has a legal commitment to maintain should be a higher priority than sites where no such commitment exists.

Opportunity: Although consequences, urgency, and responsibility are the primary factors in determining problem priorities, projects can sometimes present opportunities for meeting multiple objectives. Examples include projects that enhance ecological resources, provide public access to the river system or coastal areas, and/or provide opportunities to cooperate with private landowners or other jurisdictions in funding and implementation of a project. The prioritization procedures should allow flexibility to give higher priority to projects that meet multiple objectives.

Modifications to Problem-Prioritization Criteria Policy FHR-3:

Basin-specific modifications to the Problem Prioritization Policy (Policy FHR-2) may be made in accordance with the recommendations of an adopted basin plan and the approval of the Lummi Nation Natural Resources Department Director and the Lummi Nation Planning Department Director.

Alternative Evaluation and Selection Policy FHR-4:

Project alternatives shall be evaluated according to the following criteria:

- (1) Risks to life and public health. The effect of the project on public health and safety shall be evaluated both upstream and downstream of the site. The project must have a beneficial or negligible impact on public health and safety.
- (2) Benefits versus costs. Benefits are measured as the effect on flood damages over the entire river or coastal system; costs are measured as public and private costs for implementing and maintaining the solution over the long term. Flood-damage-reduction benefits over the entire river or coastal system should exceed long-term costs.
- (3) Environmental impacts. The environmental impacts of the project include its effect on fish and wildlife habitat, wetlands, water quality, and other elements of the natural and human environment protected by federal and tribal laws. Impacts should be evaluated both upstream and downstream of the project site. The net environmental impacts of the project (plus any mitigation measures) over the long term should be positive or negligible.
- (4) Consistency with applicable land-use plans and regulations. The project should be consistent with land-use plans for the area and should not conflict with regulations governing activities in the floodplain, riparian corridor (e.g., stream or wetland buffers), or coastal zone unless the benefits of the project justify seeking an exception from applicable regulations.

Voluntary Acquisition versus Condemnation Policy FHR-5:

Except under very limited circumstances, public acquisition of threatened buildings should be voluntary on the part of the property owner. Condemnation should be considered only under the following circumstances: (1) federal and/or tribal regulations prohibit reconstruction of the building; (2) the property in question is causing significant flood damage to other properties; (3) a property owner refuses to sell a portion of an area in which the majority of property owners have agreed to sell to the Lummi Nation; or (4) a property owner refuses to sell an area needed to complete an approved flood-hazard-reduction project.

Relocation or Acquisition Prioritization Policy FHR-6:

In addition to the criteria listed in FHR-2 and FHR-4, flood-prone private structures should be prioritized for relocation or acquisition in the following order: (1) structures with unrepaired damage from a recent flood; (2) structures with the greatest potential for future flood damage; (3) structures with repaired

damage from a past flood; and (4) structures for which relocation or acquisition would provide the greatest public or natural resource benefit.

Using Land Created by Relocation or Acquisition Policy FHR-7:

Open land created by the relocation or acquisition of structures should become either a tribal easement (if the structure is relocated to another site on the same lot) or be owned, managed, and retained by the Lummi Nation as an agricultural land, open space, riparian corridor, wetland area, recreation area, or some other similar use that is compatible with periodic flooding.

Level of Protection Policy FHR-8:

New flood-hazard-reduction projects, whether protecting new or existing development, should seek to provide protection from the 100-year, future conditions flood, plus a margin of safety. When new projects are being built to protect existing development, lesser protection may be provided where 100-year protection is not practical or cost effective. Existing flood-hazard-reduction projects protecting existing developments should be maintained at their current level of protection unless the alternatives evaluation shows that a different level of protection is warranted or that maintenance of the existing project is not cost effective.

Multi-Objective Flood-Hazard-Reduction Projects Policy FHR-9:

The Lummi Nation should, wherever practicable, design (on-Reservation) and encourage (off-Reservation) flood-hazard-reduction projects to include preservation or reestablishment of wetlands and other habitats for fish and wildlife and to be compatible with open space and recreation opportunities.

Designing for Low Maintenance Policy FHR-10:

The Lummi Nation should, wherever possible, design and encourage projects in ways that require minimal or no maintenance over the long term. Levees and bank stabilization projects should include, where possible, toe rock, setback areas, vegetated stream banks, gentle riverward slopes, and materials and placement methods that provide long-term stability to the interior and face of the project.

Applying Standards of the Lummi Nation to Nontribal Projects Policy FHR-11:

If another agency seeks the participation of the Lummi Nation in developing a flood-hazard-reduction project, the Lummi Nation should work with the lead agency to incorporate Lummi flood-hazard-reduction policies and standards into the project. The Lummi Nation should not act as a sponsor for a flood-hazard-reduction project unless the project is consistent with or exceeds tribal flood-hazard-reduction policies and standards.

Alternatives to Maintenance Policy FHR-12:

The Lummi Nation should evaluate alternatives to returning an existing project to its pre-damage condition when the original design appears to (1) contribute to high maintenance costs; (2) provide inadequate protection from flooding and erosion hazards; (3) transfer problems to other sites; (4) degrade aquatic or riparian habitat; (5) experience repetitive flood damage and repair costs; or (6) prevent an opportunity for habitat enhancement. This evaluation should occur on an ongoing basis. Alternative recommendations should be incorporated into the maintenance and/or project priorities of the responsible jurisdiction or agency. This policy is not intended to prevent emergency repairs necessary to address extreme threats to public health and safety.

Maintenance Program versus New Project Policy FHR-13:

Any project that significantly changes the cross-section geometry or length of an existing flood- or erosion-control facility should be considered a new project, and should be analyzed, prioritized, and implemented as such. Projects that do not significantly change the cross-section geometry or length of an existing facility should be implemented as part of a maintenance program.

Public Access to Tribally Funded Projects Policy FHR-14:

Tribal members should be granted access to new flood-hazard-reduction projects built with tribal funds. This access should be limited to passive uses such as fishing and hiking, which do not require any additional right-of-way or design modifications to the project and which will not increase the risk of structural damage to the facility.

Transportation Corridors for Bypassing Floods Policy FHR-15:

Road projects that alleviate or mitigate the serious threat to public health and safety caused by flood closures should receive the highest priority for federal, tribal, state, and local funding.

RIVER-CHANNEL-MAINTENANCE POLICIES**Logjam Removal Policy RCM-1:**

Accumulations of large woody debris should be removed or dislodged only if they pose a direct threat to properties eligible for protection under Policy FHR-1 and can be removed without endangering personnel or equipment. Logjam removal should be prioritized along with other project needs according to the criteria in Policy FHR-2. Logjams that do not pose a direct threat to eligible properties should not be disturbed.

Policy RCM-2:

If large woody debris must be moved, it should either be dislodged so it can continue down through the system or removed and put back into the system at the next available downstream location. If it is not practical or reasonable to return the materials to the channel, they should, if possible, be incorporated into the riparian corridor adjacent to the river channel. When woody debris is placed in the river channel or corridor, its placement should not create new direct threats to other properties.

Dredging Policy RCM-3:

Gravels may be removed from river and stream channels only if their presence poses a demonstrated direct threat to properties eligible for protection under Policy FHR-1 and only where such activity is determined to be the best flood-damage and erosion-reduction alternative available (using the criteria in Policy FHR-3). Dredging should be prioritized along with other project needs according to the criteria in Policy FHR-2. A basin-wide sediment budget, geomorphologic analysis, flood-simulation computer model, and associated Environmental Impact Statement and Biological Assessment should guide decisions related to dredging activity.

FLOOD WARNING, INFORMATION, AND EDUCATION POLICIES**Public Awareness of Flood Hazards Policy E-1:**

The Lummi Nation should make the following information available to current and prospective residents and landowners in flood-hazard areas: (1) the known flood risks of their property and the associated threats to their safety; (2) steps they can take to protect themselves and their belongings from flood damage; (3) regulations affecting floodplain-development activities; and (4) types of disaster assistance

available. This information should be provided in advance of flood emergencies, during the emergency itself (through the Lummi Nation Law and Order Department and the Whatcom County Emergency Management Division), and after the emergency has passed.

Technical Coordination with Other Jurisdictions Policy E-2:

The Lummi Nation should coordinate with governmental agencies that share jurisdiction of the Nooksack River basin to develop and adopt floodplain policies, regulations, and standards that are consistent with those of the Lummi Nation.

Sharing Information with Other Jurisdictions and the Public Policy E-3:

The Lummi Nation should provide other governments and the public with accurate, clearly presented information that helps provide an understanding of flood management recommendations and decisions.

Flood Warnings Policy E-4:

The Lummi Nation Law and Order Department should maintain and review coordination with existing emergency public-warning systems as well as methods for making such warnings available to the public on the Reservation.

EMERGENCY-RESPONSE POLICIES FOR FLOODS

The Lummi Nation's Role in Responding to Flood Emergencies Policy ER-1:

Whatcom County is the lead jurisdiction in managing and coordinating emergency public health, safety, and welfare services before, during, and after flood emergencies within the county, off the Reservation. The Lummi Indian Business Council (LIBC) is responsible for flood-management services on the Reservation. The LIBC should coordinate flood-management planning with the River and Flood Division of the Whatcom County Public Works Department and emergency preparedness and response with the Whatcom County Sheriff's Office. The LIBC should also coordinate with the U.S. Army Corps of Engineers, the Federal Emergency Management Agency (FEMA), and other agencies and jurisdictions that have a role in responding to flood emergencies.

Sandbag Distribution Policy ER-2:

The LIBC should provide a limited supply of sand and sandbags for private property owners during flood emergencies. Citizens should be responsible for requesting, picking up, filling, and placing sandbags, as well as cleaning up sandbags and sand on their property after floods. Sandbags should be placed as close as possible to the foundation of the structure being protected.

APPENDIX F

Tsunami Evacuation Brochure and Map for the Lummi Reservation

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WHAT IS A TSUNAMI?

A tsunami is a series of waves most commonly caused by an earthquake beneath the sea floor. As tsunamis enter shallow water near land, they increase in height and can cause great loss of life and property damage where they come ashore.

Recent research suggests that tsunamis have struck the Washington coast on a regular basis. They can occur at any time of the day or night, under any and all weather conditions, and in all seasons. Beaches open to the ocean, bay entrances, tidal flats, and coastal rivers are especially vulnerable to tsunamis.

WHAT IS THE DIFFERENCE BETWEEN A ‘DISTANT’ AND A ‘LOCAL’ TSUNAMI?

When a tsunami has been generated by a distant earthquake, it will not reach the Washington coast for several hours, and there is time to issue a warning. When a tsunami is generated by a strong offshore earthquake, its first waves would reach the outer coast minutes after the ground stops shaking. Feeling an earthquake could be your only warning!

WHAT CAN I DO TO PROTECT MYSELF FROM A TSUNAMI?

- Develop a family disaster plan. Everyone needs to know what to do on their own to protect themselves in case of disaster.
- Be familiar with local earthquake and tsunami plans. Know where to go to survive a tsunami. Identify an evacuation site within 15 minutes walking distance of home and/or work.
- Prepare three-day emergency kits for your home, automobile, and work.
- Take a first aid course and learn survival

skills. Knowledge is your greatest defense against potential disaster.

HOW DO I KNOW WHEN TO EVACUATE?

If you feel the ground shake, evacuate inland or to high ground immediately! A wave as high as 6 feet could reach the Lummi Reservation within 2 hours of the quake. The first wave is often not the largest; successive waves may be spaced many minutes apart and continue to arrive for several hours. Return only after emergency officials say it is safe.

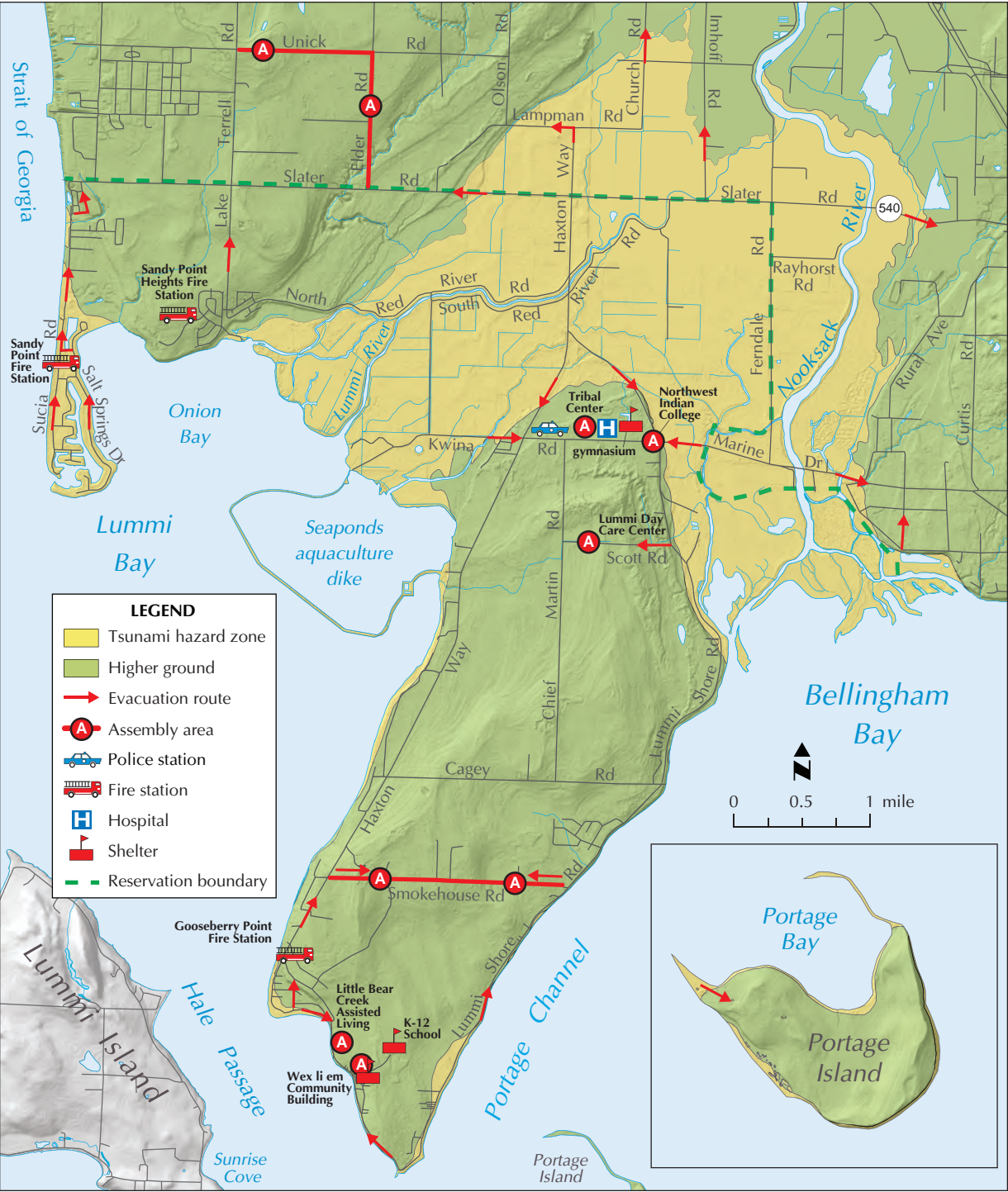
Isolated areas may not receive official warnings of distant tsunamis. If you notice a sudden drop or rise in sea level, move to high ground or inland immediately.

WHERE DO I EVACUATE TO?

The map shows tsunami hazard areas (yellow) and areas of higher ground (green). Go to the nearest high ground—at least 50 feet above sea level, if possible. If you don’t have time to travel to high ground, but are in a multi-story building, go to an upper level. If you are on the beach and unable to get to high ground, go inland as far as you can.

WHAT DO THE EVACUATION SIGNS MEAN?

Tsunami evacuation routes were developed to guide coastal residents and visitors to safer locations when car evacuation is possible. Evacuation signs have been placed along the main roads to direct motorists to higher ground. In some places, there may be more than one way to reach safer areas. These routes are marked with multiple signs showing additional options for evacuation. You will need to know the evacuation routes for your area.



HOW DO I GET INLAND OR TO HIGH GROUND?

Car evacuation may not be possible if an earthquake has damaged roads and power lines and resulted in significant debris. If this is the case, do not try to follow the evacuation routes out. Evacuate on foot directly to the nearest high ground. Avoid lakes and wetlands, which are prone to flooding and liquefaction during aftershocks.

WHAT SHOULD I HAVE IN MY EMERGENCY KIT?

You should prepare an emergency kit with a three-day supply of necessary items for each member of your family. The kit should be adapted to your needs, but keep it light and manageable in case you must evacuate on foot. Have it ready to go for immediate evacuation. Possible supplies include:

- Maps showing safe routes to high ground
- Non-perishable food and cooking and eating utensils, including can opener
- Water and a water purification kit
- First-aid kit and prescriptions
- Plastic bags for water storage and waste
- Dental and personal hygiene items
- Sturdy shoes, clothes, sleeping bag, tent
- Portable radio, headlamp/flashlight, and extra batteries
- Pocket knife, whistle, matches, duct tape, and rubber, latex, and heavy-duty gloves

WHERE CAN I STAY UNTIL THIS IS OVER?

Local emergency management has tried to designate safe assembly areas within a reasonable distance for foot traffic. If you are at risk from a tsunami, but do not have an “official” assembly area close by,

you are urged to develop a neighborhood evacuation site. The site should be outside the tsunami hazard area, easy to get to, and capable of accommodating the number of people expected. If it is on private property, you will need the permission of the owner.

After the immediate danger is past and if there is damage to the degree that you cannot return home, you should then attempt to reach a designated assembly area. Since this may not be possible, it is a good idea to inform your local emergency manager of the location of your neighborhood evacuation site.

DOES MY COMMUNITY HAVE ANY PLANS IN PLACE?

Outdoor assembly areas have been selected to facilitate delivery of emergency services. It may be several days before help can arrive, so if possible, bring your own three-day emergency kit and emergency shelter.

The assembly areas listed below are not specific in terms of boundaries. You may camp or park in adjacent areas. Take care not to block a roadway—leave access for emergency vehicles. Assembly areas must be on publicly owned property.

Designated assembly areas are LIBC Tribal Center, Northwest Indian College, Lummi Day Care Center, Little Bear Creek Assisted Living Center, Wex li em Community Building, Smokehouse Road on both sides of the street, the westbound lane of Unick Road between Lake Terrell Road, and the northbound lane of Elder Road north of Slater Road.

WHAT ARE THE EMERGENCY RADIO FREQUENCIES?

NOAA Weather Radio Blaine, 162.525 MHz
Local news updates, KGMI 790 AM.

WHEN YOU FEEL AN EARTHQUAKE:

- Protect yourself—drop, cover, hold until the earthquake is over
- Grab your three-day emergency kit
- Move quickly inland to high ground and away from low-lying coastal areas
- Evacuate on foot if at all possible because of potential road damage and traffic jams
- Do not wait for an official warning
- Do not pack or delay
- Do not return to the shore
- Listen to NOAA Weather Radio or your local radio station for information on shelter locations and emergency broadcasts
- Be alert for aftershocks
- Do not return to the beach until emergency officials say it is safe

WHO CAN I CONTACT FOR MORE INFORMATION?

THE LUMMI NATION
2616 Kwina Road, Bellingham, WA 98226
Phone: 360-384-1489
Website: <http://www.lummi-nsn.gov>



WASHINGTON MILITARY DEPARTMENT
Emergency Management Division
Camp Murray, WA 98430-5122
Phone: 800-562-6108
Website: <http://www.emd.wa.gov/>



*This brochure was produced by the
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Division of Geology and Earth Resources,
in cooperation with local emergency management officials.*

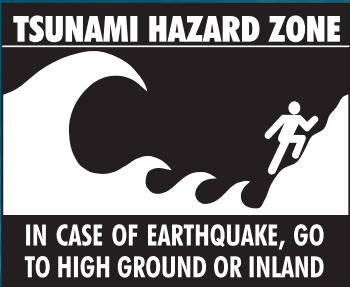


WASHINGTON STATE DEPARTMENT OF Natural Resources
Doug Sutherland - Commissioner of Public Lands

Tsunami!

Evacuation Map for the Lummi Reservation

DRAFT



Safety Tips for Whatcom County

APPENDIX G

Letter to Institutions, Businesses, and Interested Parties on the Reservation

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May 1, 2015

Mr. Chip Anderson
Lummi Tribal Sewer and Water District
2156 Lummi View Drive
Bellingham, WA 98226

Building a hazard-resilient community!

Dear Mr. Anderson,

Floods, earthquakes, storms, and other natural hazards have caused severe damage on the Reservation in the past and will do so again in the future. Since 2004, the Lummi Indian Business Council has maintained a Multi-Hazard Mitigation Plan (MHMP) as part of an overall effort to create and maintain a disaster resilient community. You can review the 2010 version of the Lummi Nation Multi-Hazard Mitigation Plan online at <http://lnnr.lummi-nsn.gov/LummiWebsite/Website.php?PageID=72>.

The goal of the MHMP is to evaluate the possible and probable damage from natural hazards and to identify actions and projects that can lessen the impact of these events. A few examples of implementation of the MHMP over the past several years include: (1) installation of tsunami towers and evacuation signs to provide advanced warning in the event of a tsunami and help guide coastal residents and visitors to safer locations, (2) acquisition of properties in the coastal flood hazard zone along Sandy Point to lower the future danger to life and property in this area, and (3) installation of 9-1-1 address signs on homes and businesses so that emergency responders can find a specific location without delay. Other mitigation measures include public education like the "Community Disaster Preparedness Safe Streets Walk" co-hosted by the Lummi Nation Police and Natural Resources departments.

For the 2015 update of the Multi-Hazard Mitigation Plan, we would like to hear from you. We are soliciting input from the public, business owners, administrators, and other interested parties. What are your concerns about recurring natural hazards on the Reservation? How is your institution or business affected by these hazards? Are there actions that you would like to see included in the new update?

Help us become a hazard-resilient community!

Please contact Kara Kuhlman in the Lummi Nation Natural Resources Department with your comments by June 15, 2015. She can be reached by phone (360-312-2128), email (karak@lummi-nsn.gov), or mail (Lummi Nation Natural Resources Department, Attn: Kara Kuhlman, 2665 Kwina Rd., Bellingham, WA 98226).

Sincerely,

Merle Jefferson
Executive Director
Lummi Natural Resources Department

Institution/Business	Identifier	First Name	Last Name	Address	City
Lummi Tribal Sewer and Water District	Mr.	Chip	Anderson	2156 Lummi View Drive	Bellingham, WA 98226
Whatcom Fire District #17	Chief		Petrie	4332 Sucia Drive	Ferndale, WA 98248
Whatcom Fire District #8	Chief		Newbold	1800 Broadway	Bellingham, WA 98225
Whatcom Fire District #7	Chief		Russell	2020 Washington Street	Ferndale, WA 98248
Whatcom County River and Flood	Ms.	Paula	Cooper	322 N. Commercial Street, Suite 120	Bellingham, WA 98225
Lummi Shellfish Hatchery	Mr.	Flavian	Point	2665 Kwina Road	Bellingham, WA 98226
Lummi Salmon Hatchery	Ms.	Linda	Delgado	2665 Kwina Road	Bellingham, WA 98226
Silver Reef Hotel, Casino & Spa	Mr.	Harlan	Oppenheim	4876 Haxton Way	Ferndale, WA 98248
Lummi Tribal Health Clinic	Mr.	Justin	Iwasaki	2592 Kwina Road	Bellingham WA, 98226
Little Bear Creek Elders Home	Ms.	Jacqueline	Ballew	2400 Lummi View Drive	Bellingham WA, 98226
Lummi Early Learning Center	Ms.	Bonnie	Hayward	2645 Kwina Road	Bellingham, WA 98226
Lummi Nation School	Ms.	Heather	Leighton	2334 Blackhawk Way	Bellingham, WA 98226
Northwest Indian College	Dr.	Justin	Guillory	2522 Kwina Road	Bellingham, WA 98226
Lummi Housing Authority	Ms.	Diana	Phair	2828 Kwina Road	Bellingham, WA 98226
Lummi Nation Planning and Public Works Department	Mr.	Kirk	Vinish	2665 Kwina Road	Bellingham, WA 98226
Lummi Nation Police Department	Mr.	Ralph	Long	2665 Kwina Road	Bellingham, WA 98226
Lummi Nation Cultural Resources Department	Ms.	Lena	Tso	2665 Kwina Road	Bellingham, WA 98226
LIBC General Manager	Mr.	Bobby	Thompson	2665 Kwina Road	Bellingham, WA 98226
Lummi Commercial Company	Mr.	Richard	Jefferson	2751 Haxton Way	Bellingham, WA 98226
Finkbonner Shellfish	Mr.	Robert	Finkbonner	2301 Lummi View Drive	Bellingham, WA 98226
Native American Shellfish	Mr.	Johnny	Felix	3622 Lummi Shore Road	Bellingham, WA 98226
Eagle Haven Trading Post	Ms.	Charlene	Williams	2924 Haxton Way	Bellingham, WA 98226
Bell-Air R/C Flyers	Mr.	Mike	Miller	3004 S. Red River Road	Ferndale, WA 98248
Sandy Point Improvement Company			General Manager	4460 Decatur Drive	Ferndale, WA 98248
Bargain Betty	Mr.	Jason	Sieber	4466 Haxton Way	Bellingham, WA 98226
Smokey's	Ms.	Theresa	Lane	4895 Ferndale Road	Ferndale, WA 98248
Vinnie's Boom City	Mr.	Vincent	Missanes	4534 Haxton Way	Bellingham, WA 98226